COLOUR AND THE OFFICE ENVIRONMENT

The effect of colour on the subjective impression of the office environment and the people within it.

By

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TO MY HUSBAND

Introduction

This dissertation has been started with the awareness that the design of interior spaces for optimum use and comfort must proceed from a fuller, clearer and more scientific understanding of human beings. Two assumptions are central in this research. One, that psychology has a very broad relevance for architects and interior designers. Two, that Human behaviour in enclosed spaces is open to scientific study. The above assumptions are made with the recognition that if human behaviour is unpredictable, it would be impossible to draw any conclusion about underlying principles or patterns. Thus, without knowing what to expect from the user in general, it would nver have been possible to produce a building for the use of others. The fact that the profession of architecture (interior and exterior) has produced buildings with some degree of success for many centuries is by itself evidence for the development of a scientific psychology for architecture and/or interior design.

Fortunately, the expanding awareness of the scientific study of man's behaviour in enclosed spaces has highlighted many unfortunate weaknesses in our present understanding of design. Weaknesses causing severe discomfort to the user are often due to erroneous assumptions about human behaviour. Among these, is the use of colour in the built environment, or rather the lack of it. The subject of colour has attracted many writers, but the fact is that our knowledge about colour is isolated and very limited. Research studies into the effect of colour and the meaning of it are spasdomic and the findings, if potentially useful to the designer, are often in a language that make it difficult to communicate with those who are the eventual descision makers of our built environment. The lack of communication is due to a number of factors.

1 - The interest in the man-environment field in the 1960's emerged almost entirely from an increasing "science" orientation among educationist stand and not from the professionals.

2 - Research is too specialized in content for most decision making situations, and thus the professional finds it difficult to incorporate the specific research findings into an already complex problem.

3 - Research is obscurely written, poorly communicated and scattered in a wide range of publications. This problem may diminish if the trendy fight between the researcher (psychologist, or social scientist) and the professional be substitute by a deeper collaboration. It is often said that researchers do not seem to value communication with professionals in the field very highly.

The blame for the lack of integration must not be placed entirely upon researchers, for the professionals are as quilty as the researcher for the stage of confussion that we are in. Some of the reasons delaying the profession's adoption of research findings are:

1 - Lack of willingness to read research. To most architects and interior designers research is boring! Among many variables contributing to this are:

a) Educational system. Lack of almost any encouragement and training in research method and their relevance to the design profession.

b) Most designers are more graphically than verbally oriented. This is evident in professional magazines with their lavishly coloured photographs which show rooms fully set with furniture and accessories imitating a living space by presenting an open book, poured wine in crystal glasses, and a nice warm fire without a sign of living people anywhere!

2 - Lack of understanding and acceptance of the fact that research is needed. Most professionals are armed with the commonly held belief that their perception of the world is gifted talent, and thus unique and valid! This perception is derived from an ego which is now having to face faulty buildings created by its own ignorance.

3 - Professionals are threatened by the research as it furnishs them at this stage with theoretical data which offers confusion to an already complex profession.

4 - The short duration of the educational system. Three-four years education is not enough for a complex subject such as architecture or interior design. One can learn the practical trainging such as draughting, rendering, structural system, etc. But, these are simply not

> enough to produced a concious, well-trained and able designer. The drab result is all around for us to see. Design students need to study methods of empirical or non-empirical research, understand the importance of it, and be able to read and make sense of the findings of other researchers.
>
> Postgraduate studies (M.A., Ph.D.) in this field often require some basic training in the scientific methods applied in empirical research. This requirement necessitates training in undergraduate studies which is hardly touched upon in the present educational system.

Similarly it is important for any researcher from disciplines other than the design field to understand the difficulty and complexity of the design process, the limitation of time, budget and many other variables that are involved with this profession. Once, the problem of communication is solved we can stand together and and hopefully work towards solutions for a better environment suitable to our physical and psychological needs.

In reviewing the present research materials, once one passes the problems of communiction by becoming aware of techniques, methods and various styles of literature employed by different researchers, one is faced with another obstacle. That is, the lack of a clear definition and hence an accepted theoetical framework enabling one to produce comparable and useful data which could be used in design process.

To avoid some of the problems mentioned above, this thesis starts with providing a brief summary of the definition of interior-design, how it communicates with people, and the profession's duties to the public, (Chapter 1).

In an attempt for a better understanding of the field of environmental psychology, and perhaps to assist the future researcher starting in this field, Chapter Two briefly reviews several theories related to environmental psychology and their limitations.

Chapter Three introduces the conceptual-framework that was pursued in this thesis. In support of this approach, several case studies done by the investigator together with supportive evidences gathered from various disciplines are discussed.

As production of a design guideline applicable to the office interior was the principal purpose of this research, many visits were made to various clerical offices in England and Scotland. The primary purpose of these visits was to gain a better understanding of the

users, and the aspects of physical environment which are in need of consideration. Chapter Four presents the two case studies that were undertaken for this purpose, and identifies the physical stimuli for further investigation.

Colour was the topic that brought the most discussion, criticizm and concern during this preliminary research. The outcome of these interviews was the formulation of the following hypothesis:

1) There are similar shared preferred colour schemes in office interiors.

2) Colour affects the preferred furniture arrangement within a space.

3) Colour affects the judgement of people within a space.

4) There is an ongoing interaction between colour (hue and value) and the rest of the physical stimuli in the visual environment, such as light pattern.

The above hypothesis are examined through several experiments presented here as, Case Study Four and five in Chapter Five, Case Study Six in Chapter Six, Case Study Seven in Chapter Seven, and Case Study Eight in Chapter Eight.

These studies illustrate the complexities and effects of colour in our environment. Much work has to be done, and it will take many decades before investigations provide answers and guidelines to many questions that will ultimately enable the designers to use colour with some confidence.

Meanwhile, in the present concept of the built environment this important element appears to have been ignored or avoided to a degree that is causing concern as to the potentially dangerous effect on the future visual well-being of society. Let's be reminded that the answer to our ignorance about the effect of colour is not found by avoiding it, but rather by using it.

CHAPTER ONE

CHAPTER ONE - A FEW WORDS ABOUT INTERIOR DESIGN

1.1 Introduction

1.2 Definition of Interior Design - The Human Environment

1.3 Interior Design as Non-Verbal Communication

1.4 The Main Areas of Interior Design

1.5 Can Interior Design Affect the Quality of Life in an Office?

1.6 Summary

A FEW WORDS ABOUT INTERIOR DESIGN

1.1 Introduction

Design is an active process which usually begins with some mental image or idea. Whether the design is a chair, a pen or a whole city, they share certain elements which are known as the design elements. These are the raw ingredients of any design, and are believed to have the characteristic of being highly expressive, or being able to make either strong or subtle statements.

In addition to the elements of design, there are concepts that have evolved to explain how and why certain combinations and relations of design either please one or seem unpleasant. These are known as the principles of design. The number of principles is not set, but there are seven which are generally considered in creating or analysing any design. They are scale, proportion, balance, rhythm, emphasis, variety and unity.

These elements and principles are used by designers for creation and change towards meaningful objectives. The success of the design, of course, depends on the skill, intuition and the background of the designer. However, the fact remains that design is a purposeful activity which acts as a means of enhancing communication in order to bridge the gap between things and people, or between one human being and another.

1.2 Definition of Interior Design - The Human Environment

> "An interior (or a building or a city) that carries too heavily and for ever the professional signature of its designer and permits no contribution from its user, may be a fine environment, but it is nevertheless a tomb".
>
> Inscape, ed. Sir Hugh Casson (London: The Architectural Press Ltd 1968)

While interior design as a profession, and as distinguished from "Decoration" is relatively new, man's desire to create a pleasant environment is probably as old as our civilization.(1)

Interior design is something which is used by living human beings. It is concerned with the arrangement of the immediate human environment and how that environment affects the user. The objective of interior design is thus to improve human accommodation and its physical surroundings through creating a living environment which is suitable for human function, including man's physical and psychological well being as a whole.

The design of an interior for optimum use and comfort must proceed from an expanded base. There is recorded research in many disciplines. Some with apparent relevance and some being evaluated as to the relevance it may possess. This is a challenge with which interior design is faced. The field is large, complex and relatively new. Those disciplines or subdisciplines which contain information useful to the interior designer, listed alphabetically, are: acoustics, anthropology, anthropometry. ecology, engineering ethology, geography, gerontology, home economics, human factors or ergonomics, illuminating engineerings, industrial design, landscape architecture, law, linguistics, medicine, operation research, opthalmology, optics, orthopedics, physiology, psychiatry, psychology, sociology and urban planning. Additions to those listed above will appear as new material is discovered and becomes available.

A brief review of materials available from various researches clearly indicate that there are behavioural implications in every design. Interior design can produce environmental habitability, a very important goal in terms of human well-being. The condition of the ultimate environment, the interiors where we live, love and work cannot help but be one of the most important factors in our survival as rational and functional human beings.

1.3 Interior Design as Non-Verbal Communication

> "The whole of environment, from the moment we name it and think of it as such, is a tissue of symbolic forms; the whole of the environment is symbol".
>
> (Rykwert, 1967)(2)

From the moment one enters any interior space, its impact on the senses becomes an instant communication, an immediate interaction without words. Whilst this impact is principally visual, (since the eyes are the prime source of sensory information), the thermal, auditory, olfactory and tactile qualities of the surroundings are perceived along with the visual information. The impression received may be clear and sharp or fuzzy or ambiguous or nothing at all. However, the fact remains that interior spaces do communicate with those who occupy them or see them and this communication usually takes place without any verbal exchange. (3-4-5)

It is the opinion of a group of behavioural scientists that the design of an interior space and its location not only can communicate with those who enter it, but can also control their behaviour. They even go so far as to claim that this is the sole behavioural determinant. The ecological psychology group, led by Roger G. Barker and Paul V. Gump are leaders in this belief. Their work, consists mainly of "non-intrusive, non-destructive" observations of how subjects use interior and other spaces over long periods of time(6-7). However, Barker mentions individual differences in defining his theories and field limits, "the environment is seen to consist of highly structured improbable arrangements of objects and events which COERCE behaviour in accordance with their own dynamic patterning".

Ecological psychology focuses on objects and the physically built environment rather than on individual people. However, this kind of view seems to be too extreme because it limits or rejects all other theories of how and why the environment can affect the actions of human beings in it or the interactions of human beings with it. More importantly, it seems to reject the notion that human beings themselves may acquire abilities to determine their actions and fate within the environment. It also pre-supposes singular non-verbal communication from the environment to the person within it, "coercing" behavior with no other instrumental factors.

The work of Barker and his group is somewhat related to the behavioural mapping techniques used by other researchers such as Harold M. Pronshansky, Willima H. Ittleson and Leanne G. Rivilin(8). Using a psychiatric ward in a hospital as a behaviour setting, these researchers have made mass studies from preset observation points of where patients are and what they are doing over a span of time.

Both groups have concentrated on determining what are occuring and/or the extent of human participation in them. Barker and his group have further developed the concept of synomorph, ie. that an activity must fit the setting in which it takes place, which may be helpful and may serve as a basis for future researchers who may attempt to identify individual stimulating or inhibiting elements in the environment.

Another group (cognitive mappers), have provided useful information describing how human beings perceive the environment and what elements in it are used as cues (non-verbal) to get from one spot to another. Almost all of this work has been carried out on exterior, rather than interior spaces. However, because it focuses on the perception of space and on special concepts, it may prove to be a useful research procedure in interior spaces. Lynch[9], Moore[10], Appleyard[11], Stea, Downs[12], Piaget and Inhelder[13] are all examples of this approach.

An interesting approach comes from Goffman[14]. He divides interior spaces into "front region" and "back stage regions". This theory emphasises the use of interiors as parts of a stage and correlates varieties of human behaviour to the parts of the interior where each is performed. Interior design is, of course the silent partner in creating the various areas for the diverse activities. The persistence of the parlour in some residences as a formal space in which to receive visitors is perhaps the clearest example of a stage in the home.

The parlour as a formal stage of first setting in which to receive visitors persists across cultures and across economic strata. Christopher Alexander and his associates[15] exmphasize the importance of the Sala - the Peruvian Parlour - as the most important element in the intimacy gradient of the private dwelling. Sala is the place where strangers are always received. Both the room and its furnishings carry that non-verbal message and it is the least intimate and most formal place to sit in the Peruvian house.

The theoretical concept also formed one of the bases for a study done by Sociologist Edward O. Laumann and Social Psychologist James S. House, which relates the decor of the living room as a "front region" and concentrates on it. They say:-

"The Living Room is the area where "performance" for guests are most often given, and hence the "setting" of it must be appropriate for the performance. Thus .... more than any other part of the house, the Living Room reflects the individuals' concious and unconscious attempts to express a social identity".

They feel that decor is rather strongly related both to a family's status and to its behaviour in certain areas of life. Their living room study was a part of the 1966 Detroit Area Study, a project of the University of Michigan at Ann Arbor, using a randon sample of 1,000 households. The researchers did not determine socio-economic status or attitudes from the living rooms visted. Rather, the respondents' socio-economic status was determined by other means and then related to the presence or absence of certain characteristics in their living rooms.

In their study, they took a visual inventory of each living room they visited. In analysing the result of these inventories, they found four styles of decor distinguishable by status and attitudes:

1.3.1. High status modern. Sleek, functional furniture. Abstract paintings and sculpture are typical.

1.3.2. High status traditional. French or early American furniture. A piano, a fireplace and potted plants are typical.

1.3.3. Low status traditional. Floral designed carpets, translucent curtains and religious objects are typical.

1.3.4. Low status modern. A television set and general disorder are typical. However, Laumann and House note that this pattern seems more the result of impoverishment than real stylistic preference.

Laumann and House emphasise that their findings are neither definitive nor final. However, their study does indicate the importance of interior design in non-verbal communication of certain attributes of the owners.

The residential interior is not the only area in which one can observe the reflection of the owner's (or user's) philosophy and attitudes. It is possible to learn much about a business simply from the look of its interior. For example the lack or existance of a formal reception area usually sets

the "front stage" and often dictates certain attitudes and expectations to the visitors. In a way, interior design determines the climate of the action and interaction on the stage. Throughout the entire corporation, the choice of finish materials, type of furniture and their arrangement enables one, within limits, to control certain aspects of traffic, communication interaction and conversation. For example the use of a table between two chairs usually sets a formal conversational distance. It is evident that seating arrangements facilitates eye contacts[17], this is quite important in determining the mood of conversation. For example, in designing the head-quarters of a corporation, the investigator asked the staff to roughly indicate the seating arrangements that they would prefer in their room. To facilitate this they were given the cut-outs of plan view of furniture. It was noticed that almost all preferred to provide eye contact with the visitor. However, the nature of this contact varied, based on the type of furniture in use. The following figures illustrate this:

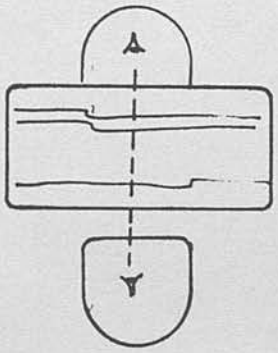


Fig. A

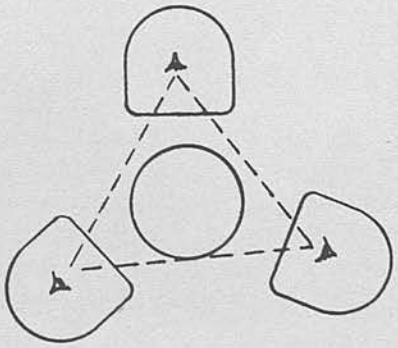


Fig. B

Direct eye contact was preferred around the work surface area where the majority of the business activity takes place, (Figure A); and "an optional eye contact" was voted for the resting and visiting area, (figure B).

Certainly, the total look of an interior space, as it is communicated to a person who enters it, influences the view of those expected to use it and what they are expected to do in the space. Formal or casual, period or eclectic "for show" or "meant to be used" are some of the obvious alternatives, can be conveyed through appropriate decisions on colour scheme, furniture style, size and arrangement, finish materials and the use of accessories.

While this discussion barely scratches the surface of interior design as non-verbal communication it does indicate some of the perceptual and symbolic aspects of this subject. It further demonstrates that the field is vast, complex, and a great amount of research still needs to be done before it successfully developes its full potential as a tool to assist us in our survival.

1.4 The Main Areas of Interior Design

There are three main areas of creation in interior design. They are inter-related, but each demands a unique knowledge and ability[18]:

1.4.1. Residential

This is living environment, the home residence where we spend most of our time. Considered one's own kingdom, it is therefore the critical objective of the Interior Designer to understand the owner's needs, family life style and relationships to their enviornment.

1.4.2. The Working Environment

The office. This is business enterprise, the work space. Here the critical objective of design is the relationship of the interior environment to workers' needs, perception and productivity.

1.4.3. The Special Interior

The specialized environment serving unique design functions; e.g. aeroplane and automobile interiors, restaurants, theater, hospitals and other special interiors. The critical need here is the understanding of the uniqueness of the product or service and its connection to the user or buyers.

An Interior Designer's job in any of the above categories is a balancing act between several forces: his own desire, the client's desire and a range of complex environmental factors. This research concentrates on working environment i.e. the general office interior, (see Chapter Four).

1.5 Can Interior Design Affect the Quality of Life in an Office?

The answer to the question posed is important because there are going to be more and more offices and office workers. In the United States as a whole, the number of office jobs was in 1980 more than that for any other form of employment. By the year 2000 it is estimated that the wages that will be paid to office workers will account for 92% of the total cost of office operations, depreciation accounting for 2% and maintenance for 6%. Therefore, increasing the productivity of the labour that accounts for so much of the total cost, becomes a prime objective of any efficient management.

Planning and design of a space wherein the workers can work happily and efficiently is one way that the Interior Designer can affect the quality of life in the office and pay his contribution to the survival of the economy. Whether or not good office design promotes more productivity per see has been questioned. There is much evidence (19 to 25) that it does. However, it will take substantial and carefully designed studies to pin down the facts. Several studies are underway and it is hoped that the answers will come in a form that designers can use.

1.6 Summary

The nature of the interior design, its purpose and the importance of it as one of the most important factors in our survival as rational and functional human beings was briefly discussed. In addition, the main areas for creation in interior design were reviewed: residential, commercial, special use areas.

This research concentrates on commercial design which includes design of a working environment (for example, the office) in which one third of a person's life may be spent.

CHAPTER TWO

CHAPTER TWO - AN INTRODUCTION TO ENVIRONMENTAL PSYCHOLOGY

2.1 Background History

2.2 Theories

- 2.2.1 Psychoanalysis
- 2.2.2 Gestalt
- 2.2.3 Behaviourism
- 2.2.4 Barker's Ecological Psychology
- 2.2.5 Kelly's Personal Construction Theory
- 2.2.6 Socio-Spatial Schema

2.3 Discussion: The Limitation of Theory in Environmental Design

2.4 Summary

AN INTRODUCTION TO ENVIRONMENTAL PSYCHOLOGY

2.1 Background History

The word "environment" represents a very large and imprecise concept. It was adopted into Middle English from the French word "environ" (meaning to form a ring, surround, envelop,[1] etc.). Then, with the adding of the suffix, "-ment" it has been generally taken to mean the "conditions or influences under which any person lives or is developed[2]".

Environmental psychology is concerned with the scienfific study of man's relationship with his environment. This indeed is a broad definition that encompasses many areas of concern such as physical and social environment; geographical environment and other related disciplines. However, the history of this subject is a brief one as it did not begin to develop a collective awareness until the 1960's. An early milestone in the U.S.A. was the Salt Lake City Conference on Architectural Psychology and Psychiatry, held in 1961. In Britain, the first of several symposia on the subject was held at the Annual Conference of the British Psychological Society at Reading in 1963. The Building Research Station, (now the Building Research Establishment), employed at least one psychologist during the 1950's and this involvement expanded during the 1960's, which brought the rise of Pilkington Building Research Unit at Liverpool University and the Building Performance Research Unit at Strathclyde University.

The first significant converence in Britain was held at Dalandhui (Strathclyde University), Scotland, in 1965; and this has been followed by similar occasions at Kingston Polytechnic, (1971), the University of Surrey, (1973), and at the University of Sheffield (1975). In the United States the large-scale interdisciplinary conferences sponsored by the Environmental Design Research Association (E.D.R.A.) form an important series.

Due to the rapid growth of interest in many countries, great numbers of conferences, journals, books, symposia, newsletters, etc., have been established since then.

The inputs have come not only from individual psychologists but also from outside establishments of psychology. This is due to the multidisciplinary

origins of the field which receive contributions from geography, planning, ergonomic, social and political science .... etc.

Whilst it is accurate to say that all studies involved in this field have common cause in seeking the understanding of man-environment interaction, it certainly cannot be claimed that they share the same ideas about how to get there or about what kind of model to use.

Most of the well known theoretical and conceptial systems, with their attendant methods of enquiry, have been applied. A brief review of these theories are illustrated in the following pages.

2.2 Theories

The differences between different kinds of psychological theory are rarely different ways of attributing the same phenomena to different causes, rather they deal with different levels of human responding, advocating different ways of observation and, most importantly, dealing with different content areas.

Theories which influence environmental psychology are at two levels. First, the broad theories such as Psychoanalysis, (Gestalt and Behaviourism). At the next level are the narrower theories which have been more specifically applied as frameworks for environmental psychological research such as Barker's ecological psychology and Kelly's personal construct theory.

2.2.1. Psychoanalysis

> Psychoanalysis was founded by Sigmund Freud and is still indissolubly associated with his name. Its beginnings cannot be dated precisely since it extended over a period of several years. By 1895, however, the evolution of psychoanalysis was well under way. Psychoanalysis has given rise to certain theories which are derived from its observational data and which attempt to order and explain that data. What we call psychoanalytic theory, therefore, is a body of hypotheses concering mental functioning and development in man(3).
>
> In brief Freud postulates an energy force driving the person from within, the libido.

The energy driving force, (motivated by the pleasure principle), seeks sensual gratification. The "ID", the resevoir of libidnous drives becomes progressively differentiated into two major and autonomous units, the EGO and SUPER-EGO. The EGO is the conscious self, that part of the self which is in contact with the external world and with which it must interact. The SUPER-EGO, (part of the subconscious), is the internalised morality of the family and society. These fundamental departments of the human psyche are in a state of continual tension. In simplified terms the ID demands gratification. The SUPER-EGO demands denial of gratification, and the ID must seek a balance between these conflicting demands within the context of the reality principle, ie., having to deal with the external world.

There has been few attempts to apply psychoanalytical theories to the field of environmental psychology. One exception is Madge (1951). Madge in arguing the importance in the planning function of distinguishing between private and public spaces applied the Freudian model. He suggested that residents in housing estates manifested modes of behaviour deriving from early childhood with respect to the emotioal ease or difficulty with which they moved from their former residence. His thesis was that the house symbolizes the mother's womb, protective and sheilding. The ease with which the child is weaned from the mother is manifested in the ease with which the adult moves from the home to the external world. Madge further suggested that repression of sensory pleasure in the womb may be manifested in the suppression of aesthetic pleasure in the house in the use of colour, decoration etc.

Having as its central core thesis that much, if not all, of human behaviour has subconscious roots, psychoanalytical thoery has the potential to contribute to the developemnt of a psychology of the environment. However, much requires emperical verfication, and that raises many difficulties. Perhaps the use of the techniques of psychoanalysis, dream anaysis and free association techniques, could yield a rich source of information concerning sub-

conscious perceptions and fears concerning external environment.

2.2.2 Gestalt Psychology

Gestalt psychology is a movement born during the 1920's and 1930's is an attempt to shift the whole direction of psychology from two existing trends. One was associationism or structuralism, which attempted to discover the irreducible molecules of congnition and sensation. The second was psychophysics, in which the attempt was oriented toward finding lawful relationships between external stimuli and experienced sensation.

The term 'Gestalt' means 'whole' or 'configuration', and the Gestalt psychologists point out that perception is not based upon isolated responses to particular stimuli, but rather as a reaction to the total stimulus field(5). The essence of Gestalt psychology is often summarized as, "The whole is greater than the sum of its parts". The implication of this is that our perception is an active reaction to the world about us and not a passive response, and that we actively structure and make sense of the stimuli with which we are presented.

Gestaltists have also stressed a synchrony between the stimulus forms of the external world and neurological processing mechanisms in the human perceiver. This gives rise to the strong innate tendencies to perceive stimuli in certain ways. "Figure" stands out from "Ground"; complex arrays form themselves spontaneously into groups; incomplete figures are under tension towards "closure"; existing continuity tends to extend itself. These "Laws of Organization" of the perceived environment seem particularly apt to our appreciation of townscape and scenery. They can however be deduced from functional theory (ie. we learn to organize our spaces in these ways because it pays off), and the Gestalt notion of neuro-physiological correspondence is not now generally accepted.

2.2.3 Behaviourism

Behaviourism is one of the most widespread theories in psychology. It, too, is a revolution against introspectionism and mentalism and attempts to replace these with proven scientific facts. This

requires that only measurable behaviour would be accepted as evidence. (This refers to the basic R-S linkage).

There is, however, a widespread distaste for behaviourism. The reason expressed is that it undermines the notion of free will and carries the dangerous threat of manipulation by Big-Brother[12]. However, Skinner, as acknowledged behaviourist, claims that these fears are unfounded and that any disadvantages are outweighed by the potential benefits.

In any case, direct applications of this approach, in environmental psychology are rare and are found mainly in the control of therapeutic environments at this stage.

2.2.4 Barker's Ecological Psychology

A brief history of this theory was given in Chapter 1. Roger Barker (1968) has been leading a team of researchers at Midwest Psychological Field Station in Oskaloosa, Kansas, who have intensively studied communities in the USA and England.

The theory comprises the systematic and carefully detailed observation of what Barker calls the "stream of behaviour"[6-7], which is made up of "behaviour settings". These are recurring patterns of activity which take place in a particular locale. In other words, "ecological psychology", is concerned with studying the spatial and temporal distributions of behaviour. The method centers around the identification of "behavioural settings", which are units of specific locations, and times with identifiable patterns of behaviour which are independent of the particular people involved. Concerned essentially with the identification of the frequency and location of types of behaviour ecological psychology is an observational method and does not involve the manipulation of experimental variables to explore their effects on various dependent measures.

2.2.5 Kelly's Personal Construct Theory

Kelly (1965) describes the development of a theory and associated techniques for dealing with personality problems. Kelly's approach enables psychotherapists to observe the way a patient makes sense of the complex pattern of people and events which influences his behaviour. ".... this approach could be adapted to examine the way people make sense of the complexities of environment, and the result of this kind of examination would constitute a reasonable basis for theorizing about environmental evaluation[9]".

The first of Kelly's formally stated fundamental postualtes is that, "a person's processes are psychologically channellised by the ways in which he anticipates events[9]." Kelly reasoned that man was capable of being his own "scientist". This view indicates that the psychologists' attempts to devise theories of man-environment interaction are no more than professional intensification of something that everyone is doing all the time.

This theory indicates that each and every experience absorbed by the person was interpreted in the light of previous experiences, expectations, and anticipation until it "made sense" (Bannister, 1969). Kelly called this process "construing" and the thing or ideas which were constructed he called "constructs". he maintained that people construed events in the world using their previous experience as a basis. When they approach an event which was wholly new then it was construed using previous experience as a "Guide" to understanding it. However, when previous experience proves inadequate in helping the person make sense of an event, he may then find that his systems of belief and understanding are seriously confounded by the new experience. In these cases anxiety or even hostility may result.

Stringer identifies "man the architect" as being Kelly's "man the scientist" in an environmental context. ".... In making sense of the continuing stream of events and experiences provided by the environments which surround them, human beings

transform accomodation into "homes" by designing, modifying, decorating, and arranging their houses until they match construing of "home". Sometimes the building falls outside the inhabitant's range of convenience for construing "home" and then if he is forced to consider living in it, he may become unhappy or anxious. If the building falls within his range of convenience he may still disapprove of it but its inadequacies should be evident in his system of construing it and he should be able to either adapt to them or overcome them.(11)

Stringer (1974) has demonstrated the potential of the PCT approach in the study of public participation in planning for redeveloping a shopping area. He addresses, however, the most difficult dilemma presented by the theory ".... that if constructs are to be truly personal the results from groups of subjects cannot easily or meaningfully be aggregated, but it is precisely this that we need for testing Hypotheses". He shows that elicited constructs can be grouped into categories by like minedness and these categories can then be taken as the items of analysis.

There are obviously considerable strengths in the PCT theory and its implied methodology. The method (Rep. Grid) enables one to obtain a model of a selected area of a person's construct system. The main strength of it is that the construct is elicited from the subject rather than imposed by the investigator. However, there is little evidence so far on the correspondence that exist between peoples' construing of the environment and their overt behavioural interaction with it. It might also be questioned that "the whole of environmental cognition is encoded linguistically or in forms for which the subject can readily supply linguistically or informs for which the subject can readily supply linguistic equivalents. Not all our images have names".(2)

2.2.6 Socio-Spatial Schema

Another theorectical approach evolved from a study of the urban neighborhood by Terence Lee (1954). The study was related to whether or not the neighborhood existed as a salient feature of life in the city and if so, whether it should be defined as a social group or as a piece of territory. It was found that the respondents neither could, or wished to distinguish the physical form from the social relationships they had within the local environment, and instead they had formed an organized synthesis of the two, which functionally was very important to the ways in which they perceived and used the city. These findings led to the formulation of the "neighbourhood in the Mind" and later to the use of the concept of the "socio-spatial schema" to represent "inner representation" or images of the environment that a person possesses.

"The concept of schema was orginally used by Sir Henry Head, a Neurologist, to describe the neutral pattern that must be progresively built in the cortex to tell us where our limbs are. He was particularly intrigued by the "phanton limb" phenomenon whereby a limb seems to its owner to be present long after it has in fact been amputated(2).

Bartlett (1932), however, attempted to explain the processes of remembering, by reacting against the notion of stimulus-response "connectionism", which implied the accretion of molecular memory traces which would be weak or strong, long lasting or short-lived, as a function of their individual natural histories and particularly of their association with reward. Instead he emphasized on the active, constructive processes of memorizing and recalling. "Schemata are modified by the selective assimilation of inputs which are relevant or appropriate to them and once this has occured, the input is dead, finished. Schemata themselves are dynamic, that is, they change in order to incorporate new material and this material itself changes them further; but they are selective in what they incorporate(2).

Lee (1976) indicates that psychologists have been always preoccupied with schemata of physical objects (the ways in which people endow objects with meaning) another word the "whatness" of the object and have neglected their context or "whereness". He argues that objects cannot be pursued as goals unless we have some idea of where they are, ".... just as everything must be something, so it must also be somewhere. It is almost impossible to conceive of an object that does not have some kind of spatial coding". He emphasizes that a socio-spatial schema is an inner representation of both physical and social objects in an integrated form. Thus, social structures are isomorphic as spatial structures.

2.3 Discussion: The Limitation of Theory in Environmental Design

A growing awareness and interest in the field of environmental psychology has been witnessed in the past two decades. This awareness has aroused serious concerns about the physical and social environment and its effect on human social, physical, and psychological interaction and man's well-being.

As the result of this concern, a great number of studies and experimentation using various psychologists, architects, planners and other related professions. The methods used by these researchers have been rather diverse. It is because of this diversity that most of the previous research in environmental psychology has involved heterogenous content and methods, ranging from physiological studies with different animal populations, to audio recordings of subjective impressions. This is partly due to the lack of clear definition or theory of environmental psychology, as well as the construciton of a method with which to analyze and integrate findings from such heterogenous studies. For this field to develop and become useful, and integration of the loosely interconnected and unspecified concerns are essential before meaningful research in the field can be done. A need for a new collaborative theory to fit the field of environmental psychology has been expressed by great number of researchers such as Canter (1970), Proshansky, H. M., Ittleson, W. H. and Rivlin,

L. G. (1971), Sommer (1966-7), Perin (1970), Mehrabian and Russell (1974).

Clearly, there is no simple answer to this complex problem but an important start could be an examination of the issues central to the field. That is, the way in which the physical environment influences people and the ways in which they in turn influence it. In illustrating these central issues Canter (1970) has examined various assumptions about the relationship between the psychological respons and the physical stimuli and they are presented as follows:

> "In general they may be summarised as follows:
>
> THAT THERE ARE CONSISTENT MECHANISMS RELATING PHYSICAL STIMULUS TO PSYCHOLOGICAL RESPONSE. - For instance, that blue rooms usually look bigger. (He refers to the contextual problems and the possibility that such relationships may grow more out of the situation in which they are made, e.g. blue room after a yellow one, than the absolute stimuli themselves).
>
> THAT THERE ARE NO CHANGES IN A PERSON'S RESPONSE TO THE SAME (OR SIMILAR) STIMULI OVER TIME. - ..... amongst the many users of a building some will have very frequent contact with it, others will visit it very rarely. Thus some will have the opportunity to find their way about it and to discover ways of dealing with any intricacies in it, whilst others will be coming to it fresh with little opportunity for having learnt about it. Many buildings, however, seem to be designed as if the users come to them with a standard set of reactions which remain throughout their contact with the building.
>
> THAT REACTIONS TO PHYSICAL STIMULI ARE INNATE. - It is a corollary of this assumption that we move through developmental stages as we mature, these stages being determined by our genetic make-up. The distinction between development and learning is thus a crucial theoretical one which helps to indicate which processes of change will be underlying themes from one age group to the next and which will be modifications wrought by the particular patterns of experience of any given individual. The

type of practical question which closely relates to this assumption is, for instance, whether very different sorts of facilities should be provided for children of different ages in an institution such as a school or a children's hospital.

THAT PEOPLE ARE ESSENTIALLY SIMILAR IN THEIR INTERACTION WITH PHYSICAL STIMULI.- Because a great variety of people are associated with the production and use of most buildings, their design often proceeds as if everyone dealt with their physical surroundings in more or less the same way. (He examines) .... the patterns which psychologists have used to describe the differences found between people. The way in which this information may be applied practically has yet to be resolved, but, clearly, knowing something of the crucial dimensions along which people may differ would provide the framework for considering the range of design alternatives. If, for example, introversion where shown to be a critical dimension in relation to coping with the physical environment, but intelligence not, then providing buildings which allow for a range of differences in introversion would be more important than allowing for differences in intelligence.

In his discussion of individual differences he frequently comes across the concept of an underlying dimension. This concept also plays an important role in many other areas of psychology and has thus developed an array of precise meanings and techniques associated with them.

THAT PEOPLE DO NOT USE SPACE IN A RANDOM WAY.- This is one assumption for which we will find much support in psychology! But the question which follows is what processes can we discern which underlie the use of space. Are there, for instance, mechanisms inherited from our animal ancestors like 'territoriality'? Or do we use space more in keeping with our human capacity for abstract thinking?(14)

Another pioneering step was the survey made by Proshansky, Ittelson and Rivlin (1970) of studies in environmental psychology. This survey clearly illustrates a few major factors which hinder identifying the field and its unique principles; these are: -

1. How to analyze and integrate findings from such diverse interests and studies as: The Effects of Redecorated Hospital Rooms or Wards (Proshansk, Ihelson, and Rivlin, 1970; Sommer, 1969); Colour Preferences (Guildford, 1939); Environmental Conditions and Driving Efficiency (Provins, 1958); Differences in Performance on Manipulative and Inspection Task Under Tungsten and Fluorescent Lighting (Lion, 1964).

2. Frequent Lack of experimental controls. For example, Winick and Holt (1961) explored the emotional response of their patients to various arrangements of a set of chairs differing in colour and shape. Ittelson, Proshansky, and Rivlin (1970) redecorated an entire room in one hospital ward and tried to relate these changes to variations in social, isolated-active, and iolated-passive behaviors. All these studies involved changes in a number of variables that were left unaccounted for. For example, how many variables are changed when an entire room is redecorated?

   Mehrabian and Russell (1974) attribute the lack of experiemntal conrols in some of these studies to the absence of conceptual framework: "such frame works would indicate which variables are relevant or (irrelevant) and which ones should be explored and which ones need to be controlled". They stress the need for a conceptual framework in connecting these diverse findings ".... The endless listings of relations among specific physical variables (e.g., noise, temperature, colour) and specific behavioral variables (e.g., Galvanic skin response, performance on a vigilance task, exploration, or semantic differential responses) must somehow be integrated to provide a concise statement of the major experimental findings. Such a statement in turn, would serve to identify those areas in which study has been neglected or those in which excessive attention has produced redundant results. Since it enables the identification of interactions among stimulus effects, a conceptual framework helps resolve inconsistencies obtained from different studies".

3. Lack of adequate definition of the phenomena under study. In discussing the definition of environmental psychology; Proshansk, Ittelson, and Rivlin (1970) suggest that the definition of any field can be either a conceptual definition (Theory), or an operational definition (a survey of what environmental psychologist do). They finally indicate that "The simple fact is that as yet there is no adequate theory, or even the beginnings of a theory, of environmental psychology on which such a definition might be based".

One of the main difficulties in formulating a definition is believed to be the difficulty of identifying or distinguishing, 'Psychology of the Environment', from the general study of Psychology. Therefore it is not surprising that researchers have often chosen specific topics for study, relying on an implicit consensus to determine which problem are relevant.

However, one area of concern has been the effect of the physical environment on emotional responses of the person within it. This area in many ways is unique to this field and encompasses most of the work carried out in this field. Another major concern also has been the effects of spatial arrangements of objects and persons on social interaction.

Some investigators have studied both the emotional and the social interaction effects of physical situations. In studies of hospital environments, patient's recovery rates, social behaviour and sense of well-being have been discussed as functions of the spatial arrangements of the patients, architecture, room decorations and furniture arrangements[26-27]. There also has been an increasing awareness of the effects of architecture and interior design on individual and social behaviour[23,24,25].

In general, environmental psychology is dealing with two basic conerns: one, the direct impact of physical surroundings on human emotions; second, the effect of physical surroundings (stimuli) on behaviour such as performance and social interaction, (Mehrabian and russell-1974).

Although these two sets of concerns provide a preliminary definition of environmental

psychology it is as yet incomplete as Mehrabian argues that the field of environmental psychology must ultimately be defined in terms of a conceptual framework, i.e. a set of concepts which summarizes diverse phenomena and principles which describes the relationships between these concepts. The set of concepts and principles may then be applied in an unlimited number of ways to the particular problems that are encountered[2].

2.4 Summary

A brief review of environmental psychology and the various theories and methods applied to the studies in this field was made. It is evident in reviewing these studies that the major concern of environmental psychology has been with two areas of research, i.e., the emotional impact of physical stimuli and the effect of physical stimuli on a variety of behaviours such as job performance, social interaction, etc.

It is apparent that rather diverse methods of study have been applied which resulted in many heterogenous findings. This has been blamed upon the lack of a clear definition of environmental psychology, and a conceptual framework by which a connection and integration of these heterogenous findings become possible.

CHAPTER THREE

CHAPTER THREE - EMOTIONAL IMPACT OF ENVIRONMENT

3.1 Intermodalities Responses

3.2 Case Study - I

- 3.2.1. Method
- 3.2.2. Procedure
- 3.2.3. Analysis
- 3.2.4. Discussion

3.3 Case Study - II

- 3.3.1 Procedure
- 3.3.2. Analysis
- 3.3.3. General Discussion and Conclusion

3.4 Summary

EMOTIONAL IMPACT OF ENVIRONMENT

In order to understand man's interaction with various environments, it is necessary to point out those responses that are the immediate result of stimulation and that occur in varying degrees in all environments.

Studies of synesthesia, physiological reaction and the semantic differential show that there are basic responses that exist across sense modalities (responses common to all types of stimuli, regardless of the sense modality stimulated)[1]. These evidences show that emotional reaction represent the common core of human responses to all types of environments. This chapter represents a brief survey of rational and supportive evidence for the selection of these basic emotional reactions and the report of a case study by the investigator.

3.1 Intermodalities Responses:

Experiemntal studies have provided a great pool of evidence which support the existence of intermodality responses. These evidences are grouped under synesthesia, physiological and semantic differential(1). Apart from experiemental studies, the every-day observation of different cultures provides additional support. For example, the general opinion is that red and orange are 'warm' and exciting colours, whereas blue and green are cool and soothing. Or, in many countries (Middle East, Greek, Italy and Spain) a middle aged woman, particularly a widow, is socially not allowed to wear red or other bright colour as these colours are believed to be youthful and provacative.

Experiemntal studies have repeatedly shown that stimulation of one sense can result or affect perception in another. This intermodality association seems to be shared by different cultures.

Studies with 'photistic visualizers' (a person who visualizes auditory stimualtion) indicate that such persons visualize exciting music in bright colours or sharp angular figures, and slow music in rounder forms and softer colours, (Karwoski and Odbert, 1938; Karwoski, Odbert and Osgood, 1942; Luria 1969). Zietz (1931) found that tones of various frequencies had different effects on after images. For instance, after images flickered as a function of a "vibrating" tone's frequency. For low-frequency tones, the after images were darker, warmer, softer and vaguer contours. For tones of intermediate frequency,

after images had sharper contours and were in brighter, colder, clearer, and harder colours. For high frequency tones, rounded after images were occasionally transformed into squarish forms. Zietz noted that the association was not always one way - visual experiences could likewise influence audition. For instance, when the room was well lit, his subjects judged tones to be of higher frequency than when the room was dark.

Osgood (1960) has explored the synesthesia tendency and noted:

> "There is ample evidence for visual-verbal synesthesia within our own culture. As early as 1921, Lundholm (1921) reported data on the "feeling tones" of lines: that SAD was represented by large, downward directed curves; that MERRY was represented by small, upward-directed lines; that GENTLE was represented by large, horizontally-directed curves, and so on. Poffenberger and Barrows (1924) confirmed and extended the relationships reported by Lundholm. Karwoski, Odbert, and Osgood (1942) were able to demonstrate similar relationships between word meanings and the synesthetic drawings of photistic visualizers. More recently, Scheerer and Lyons (1957), Hochberg and Brooks (1956), and McMurray (1958) have reported Western intracultural consistencies in relating line drawings and/or verbally defined visual dimensions to connotative meanings or feeling-tones. As far as I am aware, the present study is the first attempt to demonstrate that the visual-verbal synesthetic relationships characteristic of our own language/culture community are shared by peoples who speak different languages and enjoy different cultures- the Navajo, the Japanese, and the Mexican-Spanish living in the American Southwest. The over-all similarities in synesthetic tendencies across thes groups are impressive - when the synesthetic relationships that are significant (.01 level) intraculturally are tested for cross-cultural agreement approximately 90% of the relationships prove to be in the same direction. We can conclude with confidence then that the determinants of these synesthetic relations are shared by humans

everywhere - to the extent that our sample of "everywhere" is representative .... The present study and others along the same line (Kumata, 1957; Kumata and Schramm, 1956; Suci, 1957; Triandis and Osgood, 1958) strongly support the position that, for certain aspects of cognitive behavior at least, "world view" may remain relatively stable despite differences in both language and may remain relatively stable despite differences in both language and culture .... The phenomena which seem to display generality across human groups regardless of language or culture are essentially connotative - the affective "feeling tones" of meaning which contribute to synesthesia, metaphor and the like ....

"Finally, we may inquire into the reasons behind similarities in connotative systems despite language/culture differences. First, by virtue of being members of the human species, people are equipped biologically to react to situations in certain similar ways - with autonomic, emotional reactions to rewarding and punishing situations (evaluation), with strong or weak muscular tension to things offering great or little resistances (potency), and so on - an hence they can form connotative significances for preceived objects and their linguistic signs varying along the same basic dimensions. Such connotative reactions enter into a wide variety of meaningful situations, are therefore broadly generalized, and provide a basis for synesthetic and metaphorical transpositions. Beyond this shared connotative framework, there are many specific relations between human organisms and their generally similar environments whose stability can be the basis for synesthetic and metaphorical translations. These may be either innate to the species or developed by learning under similar conditions. An example of the former (innate) basis may be the common association of the red end of the spectrum with warmth and activity and the blue end with coldness and passivity. An example of the latter (acquired) basis may be the common association of visually large with auditorily loud - it is simply

> a characteristic of the physical world that as any noise - producing object approaches or is approached, increases in visual angle are correlated with increases in loudness. These "homotropisms" and experiential contingencies may be expressed in language but are independent of the structure of any particular language".[6]

It is important to note that some intermodality association can be attributed to learned associations, but there are more basic affective reactions which account for most synesthetic association. To further explore and illustrate this association, the investigator conducted the following experiments.

3.2 Case Study on Visual Verbal Synesthetic

In search for further evidence regarding the intermodality response (visual-verbal synesthesia) two studies were devised by the investigator. The objective was to re-examine that there is a similar relationship between the words' meanings and the synesthetic drawings of the photostic visualizers.

3.2 Study I

3.2.1. Method

An initial questionnaire was prepared for eliciting words which would be descriptive of various human emotions such as sad, happy etc. An attempt was made during this stage to gather descriptions of as many human emotions as possible. (See Appendix 1-A for questionnaire). The questionnaire was responded by 53 participants differentiated by age, sex, and social background. It is interesting to note that in spite of the complete freedom given for the expression on the number of descriptors, a limited number of words were obtained to account for the entire emotional responses. These words are arranged alphabetically in Table 3.1, the words with apparent similar meanings were reduced, (ie. pretty, beautiful).

Angry	Friendly	Relief
Anxiety	Gentle	Relaxed
Arousal - Aroused	Happy	Sad-ness
Controlled	Hate	Secure
Dominant	Heaviness	Stimulated-ing
Dull	Hope	Tense
Excited-ing	Love	Ugly-ness
Fear	Noisy	
Free	Pleasure, Pleased	
Fresh	Quiet	

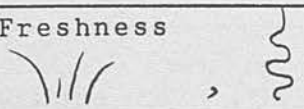
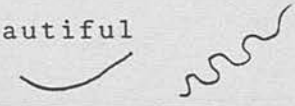
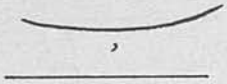
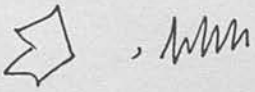
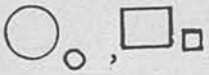
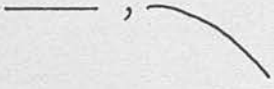
Table 3.1 presents the list of descriptions elicited from questionaire one.

3.2.2. Procedure

The twenty-seven words above formed a second questionaire. These descriptors were tabulated randomly to minimize any similarity between them. This questionnaire was then distributed to forty-six office employees of Scottish origins (22 male and 24 female) between the ages of 23 and 55. They were asked to draw an image (line, form, shape... etc.) that represents the emotion and feeling of each of the twenty-seven words listed in the questionnaire, (see Appendix 1B).

3.2.3. Analysis

An attempt was made to first tabulate all the various symbols which represented each word. Then groupings of the similar symbols were made in order to identify the symbols most used. Separate tabulation was made for different groups of age and sex, but no difference was observed and therefore the data was put together for final analysis. Table 3.2 represent the summary of final analysis.

Happy 	Soft upward curve, ($28S_s$).
Freshness 	Soft irregular curve, or, a group of individual soft upward curves, ($24S_s$).
Heavyness 	Solid square or rectangle, ($28S_s$).
Beautiful 	Irregular soft slanted curve drawn, or, single upward curve, ($24S_s$).
Hope 	A semi vertical curve, ($30S_s$).
Relaxed 	A soft horizontal curve, or, a straight horizontal line, ($29S_s$).
Sad 	A downward curve, often oppostie to the symbol used for happy ($32S_s$).
Stimulating 	Continuous irregular sharp curve, ($30S_s$).
Ugly 	Variably with irregular short continuous sharp curves, or irregular angular shape.
Dominant 	Symbolized by 2 enclosed figures with one figure being smaller than the other, ($32S_s$).
Arousal 	Sharp irregular curve upward. ($28S_s$).
Dull 	A horizontal line or, a soft downward curve representing downside of hill. The latter was used by the majority of ($21S_s$).

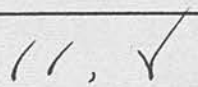
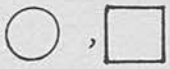
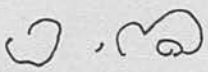
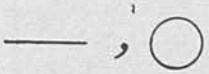
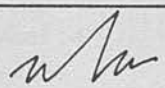
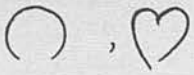
Free		Combination of two or three curves often symbolizing "fly", 19 subjects used the latter symbol.
Secure		Enclosed figure, ($18S_s$).
Anxiety		Slanted irregular curve. ($30S_s$).
Controlled		An enclosed shape, ($29S_s$).
Relief		Soft horizontal curve, ($25S_s$).
Friendly		Irregular soft curve, ($28S_s$).
Noise		Series of irregular sharp curves, ($30S_s$).
Hate		Sharp or soft downward curve, ($24S_s$).
Quiet		An enclosed figure or straight line. (24).
Gentle		Semi horizontal upward curve. ($27S_s$).
Fear		Slanted sharp curve. (29S)
Love		The traditional symbol of heart. (32).

Table 3.2 - Symbols elicited from Study I.

3.2.4. Discussion

The overall similarities in this study are impressive. The symbols used to illustrate feelings of sadness, gentle and happy are similar to the findings by Lundholm, H (1921).

An interesting discovery from this study is that three categories of visual images were consistently used to visualize the various emotional responses. These figures are: soft curves, enclosed shpaes and sharp curves. A grouping of the words under each category was made. Table 3.3 represents the three categories of form, and the words with which they were associated. Table 3.4 illustrates the histogram of some of the words under each category.

No. of S_s	Soft Curve	No. of S_s	Sharp Curve	No. of S_s	Enclosed Shape
28	Happy	30	Stimulated	28	Heavyness
24	Freshness	23	Ugly	32	Dominant
24	Beautiful	28	Aroused	22	Red
29	Relaxed	30	Excited	29	Controlled
32	Sad	34	Anxiety	16	Quiet
27	Dull	30	Noise	18	Secure
30	Free	14	Hate		
28	Friendly	29	Fear		
25	Relief				
30	Grey				
27	Gentle				
12	Quiet				
32	Love				
30	Hope				
10	Hate				
30	Pleasure				

Table 3.3 - Three catagories of form elicited from Study I.

To further examine the above findings, fifteen words were selected from Table 3.3 to form a second questionnaire for further study reported overleaf.

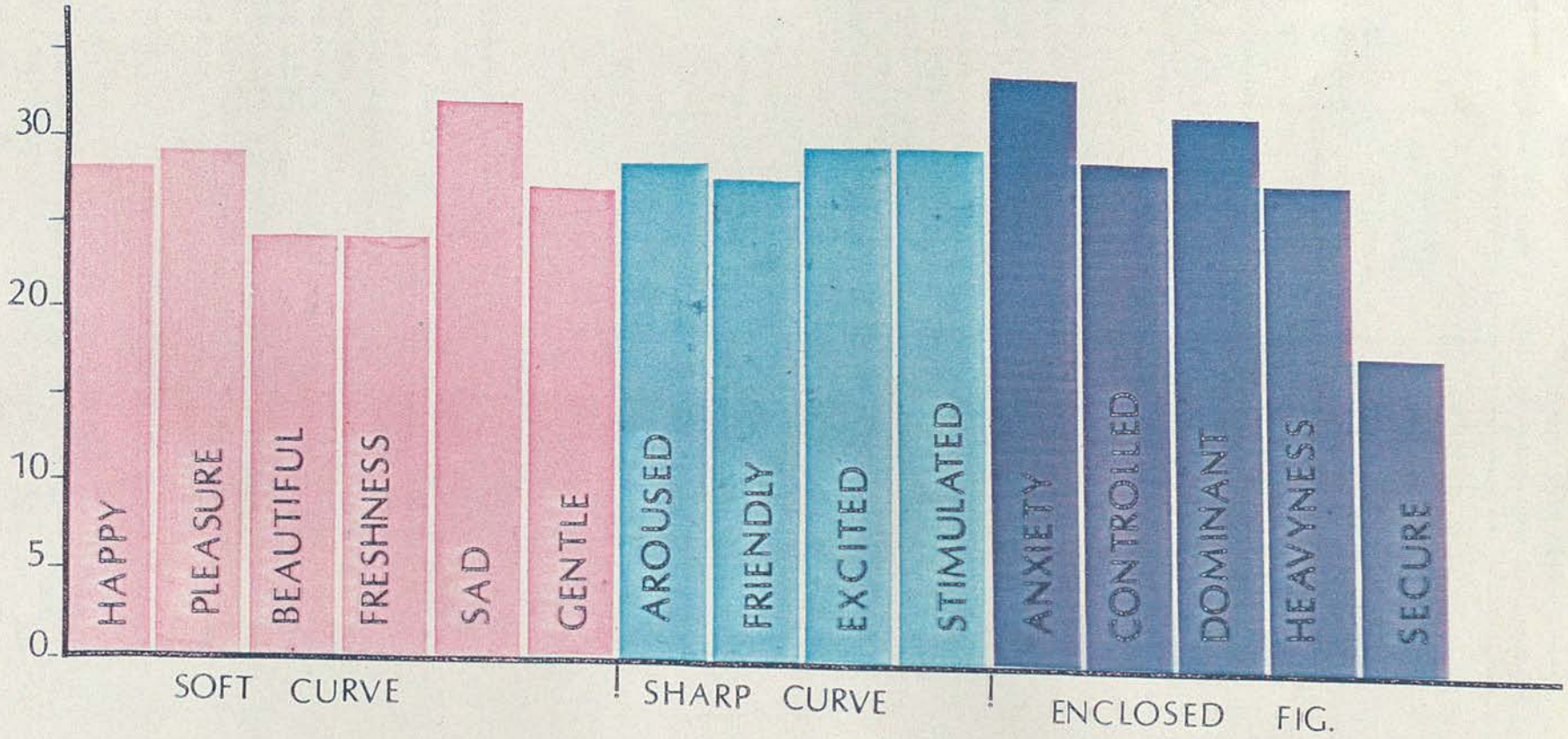


TABLE 3.4 HISTOGRAM ILLUSTRATING THE RESULT OF STUDY I WITH 46 S_s

3.3 Case Study II

The fifteen words formed a questionnaire in order to test the validity of the result elicited from Study I. (See Appendix 1C).

3.3.1. Procedure

The above questionnaire was distributed among another group of office employees of Scottish origins 18 participants (13 male and 10 female, between 22 - 35 years old) responded to the questionnaire. The questionnaire contained the symbols and the words into two individual groups, completely randomly presented to minimize association. Subjects were asked to read each word and then look at the symbols in order to choose the image that is most representative of that word.

3.3.2. Analysis

The method of analysis was to tabulate the number of subjects who selected the appropriate symbols. Table 3.5 presents the result. A further tabulation was made in order to find out if the three visual categories of emotional responses would again emerge, (ref. Table 3.6).

Most of the words were paired under their appropriate visual representation. It is interesting to note however, that those which were not paired with the same representation, were consistently paired under the same categories of figures (ie. soft curve, sharp curve, enclosed shape) mentioned above. Table 3.7 represents the histogram of the words under these categories.

S_s	Emotional Response	S_s	Emotional Response	S_s	Emotional Response
15	Anxiety	14	Excited	18	Sad
13	Aroused	8	Freshness	26	Stimulated
9	Beautiful	12	Gentle	12	Warm
15	Cold	18	Heavy	10	Secure
16	Controlled	16	Happy		
16	Dominant	8	Pleasure		
9	Friendly				

Table 3.5 - Number of subjects who paired the emotional responses under the appropriate symbol.

S_s	Soft Curve	S_s	Sharp Curve	S_s	Enclosed Figure
18	Happy	18	Stimulated	18	Controlled
18	Sad	18	Anxiety	18	Dominant
17	Beautiful	18	Excited	18	Heavy
16	Gentle	16	Aroused	14	Secure
16	Pleasure				
14	Freshness				
15	Friendly				

Table 3.6 - Number of subjects who paired the emotional responses under the appropriate categories.

It is interesting to note that this experiment was repeated by the Investigator two years later in the United States of America. The group of subjects participated in this study were 48 first year students of Colorado Institue of Art (Caucasian origin) between age 18 - 35. The results were remarkably similar to those obtained from the Scottish origin, (ref. Table 3.8), and the three categories of visual representation emerged with their related emotional responses.

3.3.3. General Discussion and Conclusion

The above studies bring the emotional responses into three groups via the category of their visual representation. The first category deals with emotional responses related to evaluation of aesthetic and pleasure judgements; the second presents feelings of excitement and stimulation, and the last category deals with senses of control, dominance and security.

These studies support the notion of the existance of intermodality responses not only within a culture but across various cultures. Every-day observation of intermodality associations, studies of synesthesia, physiological reaction and semantic studies all show evidence of the existance of the following three groups of responses:

First Category:

There is a well defined physiological mechanism associated with the experience of pleasure-pain. Physiological studies on correlation of pleasure and pain led to the identification of pleasure-pain centres in the midbrain. Electrical stimulation of areas of the hypothalamus and certain mid-

brain nuclei is pleasant, and stimulation of lower parts of the midline system is painful and this mechanism is common to all the sensory modalities, (Heat, 1963, 1969; Old, 1956). [For further information see Mehrabian and Russell (1974)].

Second Category:

The concept of arousal, Berlyn (1960) wrote that this is "one of the variables that would have to be assigned a value if the psychological condition of human being or higher animal at any particular time were to be adequately described. It is a measure of how wide awake the organism is, of how ready it is to react. The lower pole of the continuum is represented by sleep or coma, while the upper pole would be reached in states of frantic excitement".

Other research work challenges this unitary conception of arousal (Lacy, 1967), "The evidence shows that electrocortical arousal, authonomic arousal, and behavioral arousal, each complex in itself ... (and which) in general occur simultaneously. In other words, the assertions of activation and arousal theory seem to me to be true only in an actuarial sense. The limitations of our present knowledge make it impossible to say at present with what frequency and under conditions these "arousals" do occur together".

It is apparent that, at this stage physiological evidence has not established the exact nature of the arousal response(s), nevertheless it does support the notion of basic cross modality responding. Also, there is further evidence that several aspects of physiological arousal correlates highly with verbal self-reports of arousal state (Thayer, 1967; 1970).

Physiological mechanisms, reviewed previously, support the idea of the existence of basic reactions which cut across sense modality distinction and distinguishes pleasure and arousal as two dimensions. It is interesting to note that separate sources of evidence also support this notion. Studies of semantic differential (Osgood, Sucis and Tannenbaum, 1957; Snider and Osgood, 1969) characterize human

judgements of, or reactions to, stimuli of any degree of complexity. These studies defined arousal (the activity factor that was obtained from studies with this method) and pleasure (the evaluative factor) as basic responses to stimuli, and also suggested a third dimension (potency).

Third Category:

State of emotion dealing with feeling like dominance-submissiveness. Behaviourally this dimension can be measured in terms of postural relaxation and is independent of pleasure and arousal. [1,16,17]

The above factors also emerged from other studies using the semantic differential scale, (Tucker, 1955; Solomon's, 1954; Mehrabian, 1972, 1974).

In general, the evidence has shown that human judgements of diverse samples of stimuli can be characterized in terms of three dimensions: evaluative, acitivity, and potency. These dimensions were termed pleasure, arousal and dominance by Mehrabian and Russel (1974). Further studies are needed for more suport of these responses in order to assist us in understanding man's interaction with various environments, as we can then focus on the relation of these emotional response dimensions to the physical aspects of environment in order to determine a variety of approach-avoidance behaviours.

3.4 Summary

A brief review of some of the available literature in synesthesia, physiological reactions and particularly semantic differential suggest that there are three basic emotional resonses elicited by stimuli. These are pleasure, arousal and dominance.

In search for further evidence, a case study was formulated by the investigator and is reported in this chapter. This study is related to viusal-verbal synesthesia and provides further support for the above notion.

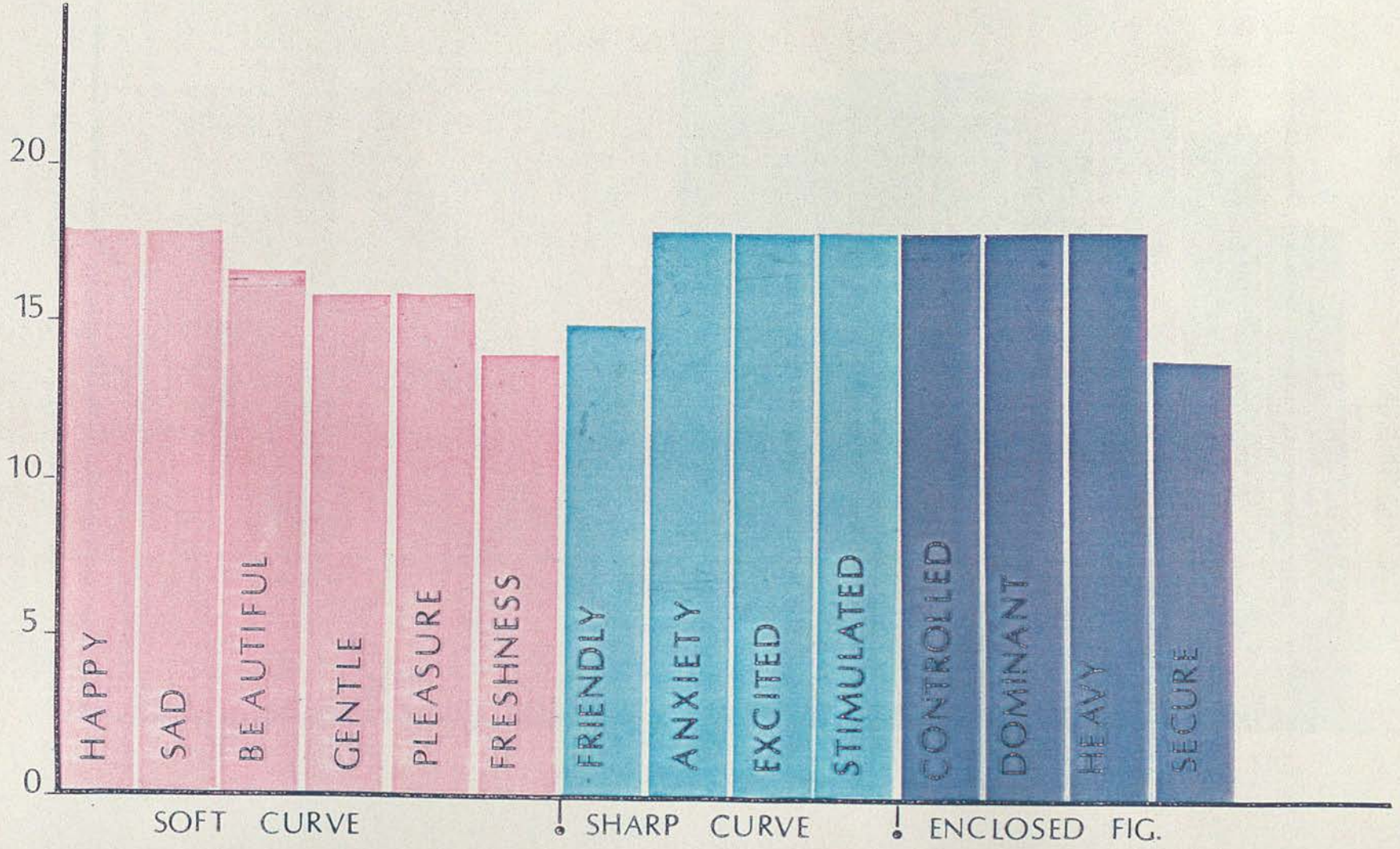


TABLE 3.7 HISTOGRAM ILLUSTRATING THE RESULT OF STUDY II WITH 18 S_s

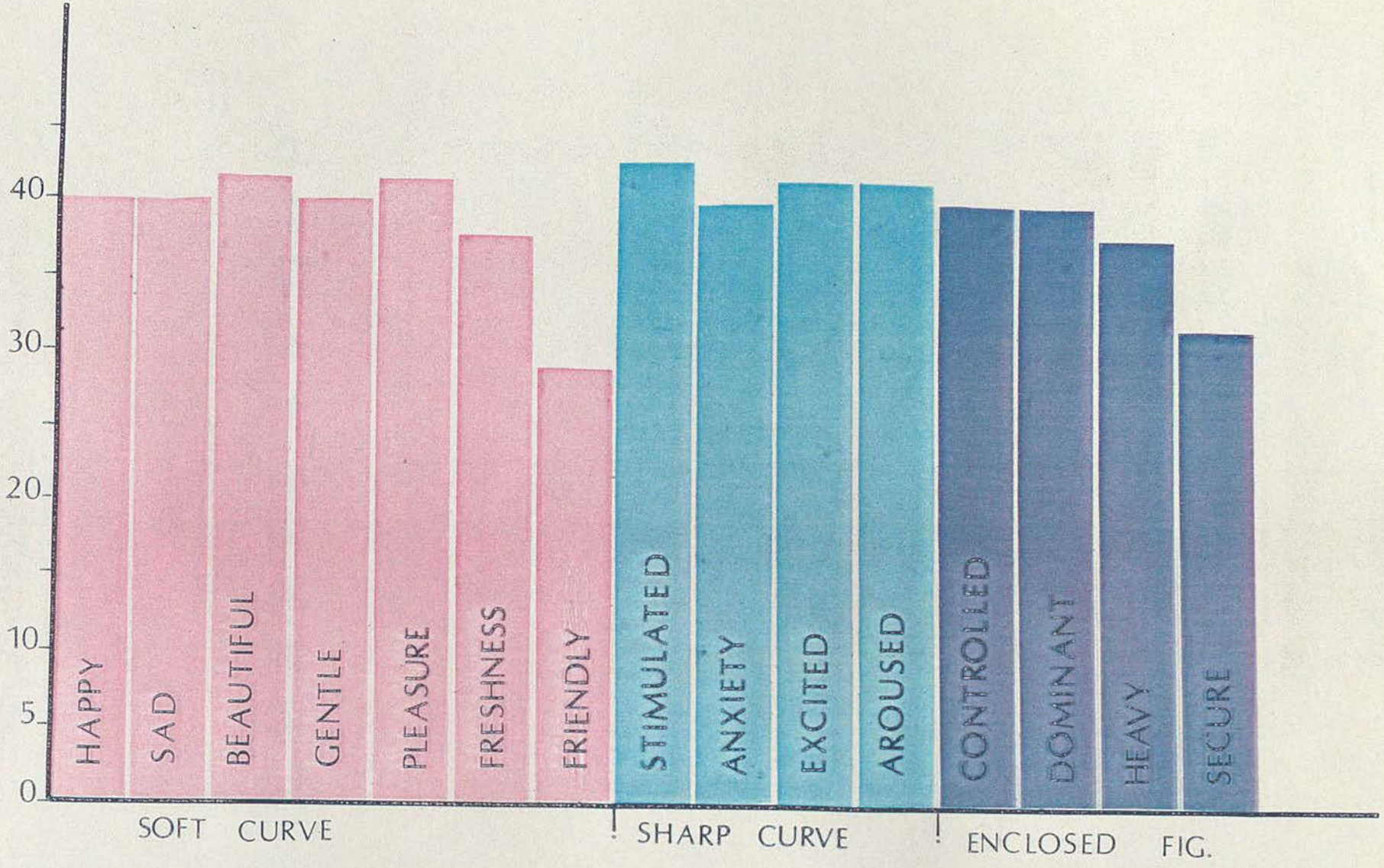


TABLE 3.8 HISTOGRAM ILLUSTRATING THE RESULT OF STUDY WITH 45 S_s IN U.S.A

CHAPTER FOUR

CHAPTER IV - LIFE IN THE OFFICE INTERIOR

4.4 Conclusion

4.5 Summary

Life In The Office Interior

4.1 Introduction

It was mentioned earlier that the main activities of interior designers today can be divided into roughly three different categories: spaces for work, spaces for living and special - purpose interiors.

Regardless of the type of interiors to be designed, the designer has to consider all the functional and aesthetic requirements of the environment, because design is a solution to a problem, and not just a matter of combining beautiful forms, textures, colours, and materials. Every interior has some function and purpose. It is the designer's obligation above all to deal with the required function. An interior that does not "work" might be an attractive stage set or window display, just as a building that does not work might be an interesting piece of sculpture; but if the interior does not work for its stated function, it fails on the most important level of design.

Traditionally the notion of "function" has been narrowly associated with those technical and mechanical factors which exist in each project. Researchers in environmental psychology have provided us with the awareness that failure in providing a pleasant visual environment can be harmful and detrimental to the performance and productivity of the job in the long term. It is argued that the negative effects of visual environment can be more hazardous than mere failure in providing enough light, heat or other physical factors. Failure in a mechanical system can be detected easily and hence the remedial action can be taken immediately. Whereas the emotional and psychological effects of the visual environment are influences which act over a long period of time and are more difficult to predict and detect. Hence, the recognition of the problem is often too late. Furthermore, even if the problem is identified, the remedy may also take a long time to have its effect. Therefore, one must argue for a new and more comprehensive definition of "function". No longer can industry and the professions (ie. designers architects, and planners) afford to hide behind the false facade of "Functionalism".

One work space which deserves a lot of attention is office space (ref., Chapter 1). There has been a considerable amount of research in this area, but

little which can assist the designer in his decision making on manipulation of the design elements. Therefore, this study deals with identification of the design considerations for the visual environment through the eyes of the users. The area that this study will concentrate on is the direct impact of physical visual stimuli on users' emotions. It is hoped that the results of this study will provide the designer with some practical guidelines rather than just the production of another empirical study. A brief review of the major trends in office design will be helpful in illustrating this point.

4.2 Brief Review of Office Landscape

Office landscape started in Germany about twenty years ago from the concepts of Eberhard and Wolfgang Schnelle of the Quickborner Team, a firm of management consultants from the town of Quickborn in Germany. In Germany the word is "Burolandschaft", Office landscape was not started by an interior designer or an architect - it was started by management consultants, and the original objective was efficiently in the use of personnel and space.

From a design point of view a very simple definition of office landscape would be an office without full height partitions which is laid out in a communication - oriented fashion. It was basic to the "Landscape" idea that partioning be avoided. Even so-called moveable partitions which take time and money to move were, and are, considered to be barriers to communication and flexibility. Without partitioning, variations to accommodate changing work patterns becomes both quick and inexpensive. Communication is believed to be easier in an office space without subdivision. There is a saving in space resulting from the sharing of circulation space which otherwise would have to be duplicated in each private space, and the reduction in emphasis on the symbolic values of status turn out to be helpful to office morale and work efficiency. Further, it facilitates change as well as expansion.

However, with all the merits of open plan office system mentioned above, several serious problems have become evident. Noise, the loss of privacy, and visual environment are the major concerns. Due to these problems there have been numerous studies evaluating the advantages and disadvantages of landscaped offices (ref. reference). There also have been some recent attempts to create semi-private areas by arrangements of furniture, screens, and storage units in ways which closely approach the

private offices of more conventional practice.

Research in this field varies from human engineering that is to say, attempting to relate work efficiency and work performance with various physical stimuli such as room temperature[6], background noise[1], lighting level[10], to optimum office size[11], etc. While these studies have provided us with some technical guidelines in dealing with accoustical requirements, planning, lighting levels, etc., for better performance and productivity, not enough research is oriented towards visual environment. Hence the designer (architect - interior designer) has to rely upon his intuition and skill. With this in mind two exploratory studies were conducted and are reported as case Study III.

4.3 Case Study III -"Interview With Office Workers"

The effect of buildings on behaviour are very subtle, and the reasons behind them need to be known. The easy way to find this out is to ask people to express their thoughts, feelings and needs. Thus, an exploratory study was undertaken in search for more evidence, and also specific topics for research. Several interviews were conducted with general clerical and administrative office workers in the cities of Edinburgh, Leicester and London.

4.3.1 - Objective

The purpose of this study was two fold:

1) To find out about users' reaction to their working environment.

2) To establish the important aspects of office deisgn, primarily from the visual point of view and its relevance to job satisfaction.

4.3.2 Method of Approach

A large number of interviews were conducted with office workers in various cities of Edinburgh, Leicester, and London. A total of three hundred office workers age 18 to 55 were interviewed. The visits made to these offices were not arranged in advance and were based on putting forward a request for interview on arrival.

These interviews were used to provide a ground for research topics likely to assist the designer in the design process.

4.3.3 - Population and Sample Used

The population from which the sample was drawn was clerical workers in general. Although the investigator was aware that the great differences existing within this population might yield differences in responses, unfortunately the definition of a more specific sample was not possible due to the limitations of time together with the limitation of the number of the participants available to the investigator in each office.

Two ways of eliciting information from these visits were selected. First, conducting an informal interview (Study III-A) and second, gathering information through a questionnaire (Study III-B) which followed immediately the informal interview.

4.3.4 - Study III-A - Informal Interview

This study was taken prior to submitting the formal questionnaire (Study III-B). The interviews followed an informal format in order to reduce any tension which may have existed due to being interviewed. Each participant was asked to complete a form in order to assign his/her approximate work station (desk location) on a grid. (Ref. Appendix - IIA).

4.3.4.1 - Procedure

The method of selecting people to interview was simply to take any person available and willing to participate. The discussion usually started with an introduction by the investigator about the reasons for the interview and the vital purpose of gathering any possible information.

A number of general inquiries were then put forward about "whether they like their working environment, or the location of their office". This was usually followed by a free ranging discussion. The method elicited the points of interest, of the users, and their subjective views, and consequently

identified the areas considered of greatest importance. Following is the report of the obvious topics raised from the discussion.

4.3.4.2 - Report on Issues Elicited During Inteview

Ceiling height, colour scheme, floor covering, heating and ventilation, general layout, lighting and view through window are some of the topics discussed and are reported here in alphabetical order.

4.3.4.2.1 Ceiling Height

This topic created long discussion. Preference in ceiling heights elicited a mixed response. On one hand comments were made that a "low" ceiling could be oppressive and negative, and on the other hand a "low" ceiling was considered friendly and cosy.

However, the comment was often made that the preference of ceiling height is dependent on room size and the existence of the window. In other words, the smaller the room size, the less often the preference for a high ceiling was indicated. Further there was an indication that a higher ceiling would be preferred in windowless offices.

There has also been some indication from other studies through observation that workers located near the centre axis of the room were more conscious of the height of the ceiling. Table 4.1 and 4.2 are drawn based on the chart given to the subjects at the beginning of the interview.

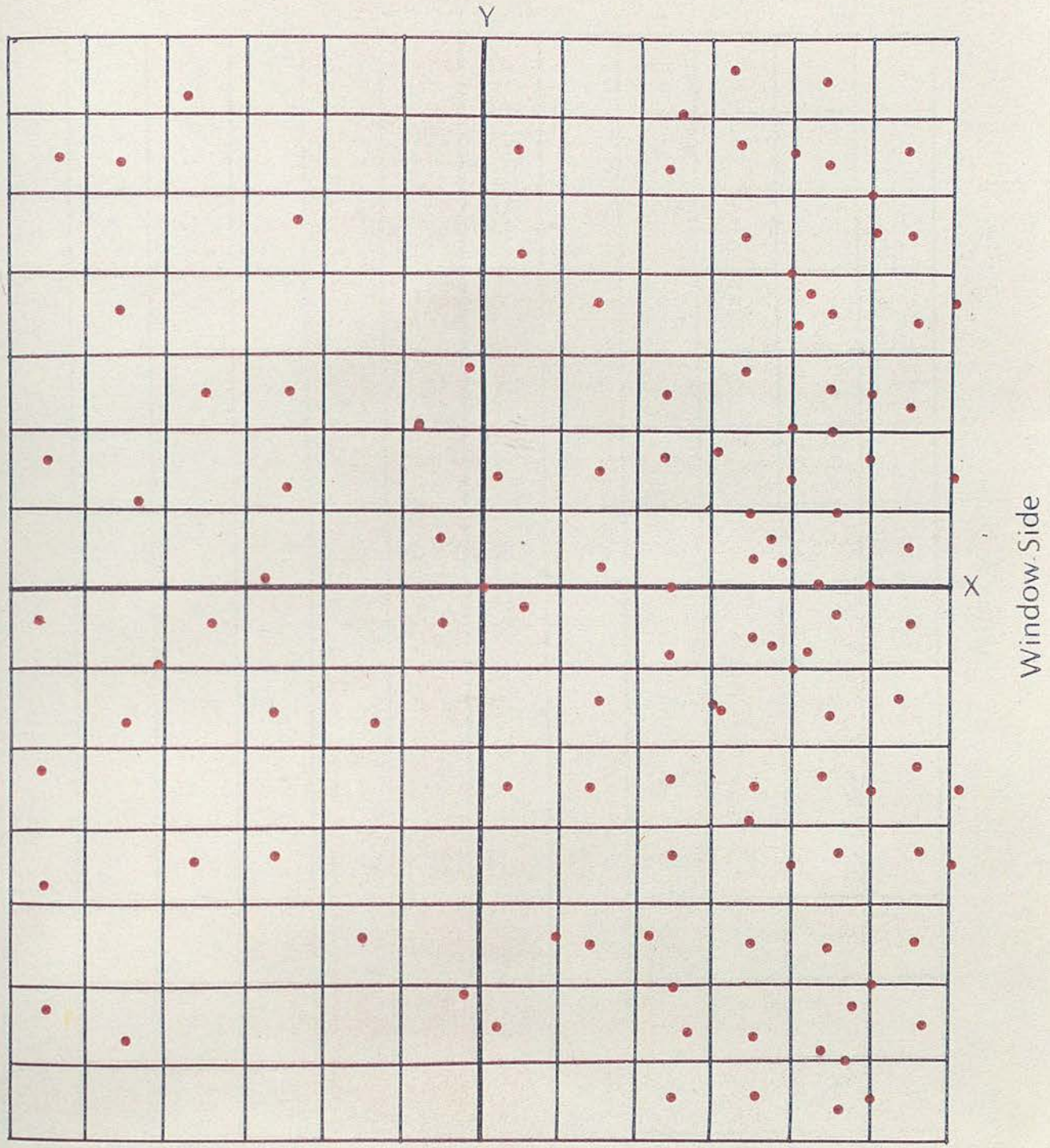


TABLE 4.1 PRESENT THE LOCATION OF THE SUBJECTS WHO DID PREFER LOW CEILING

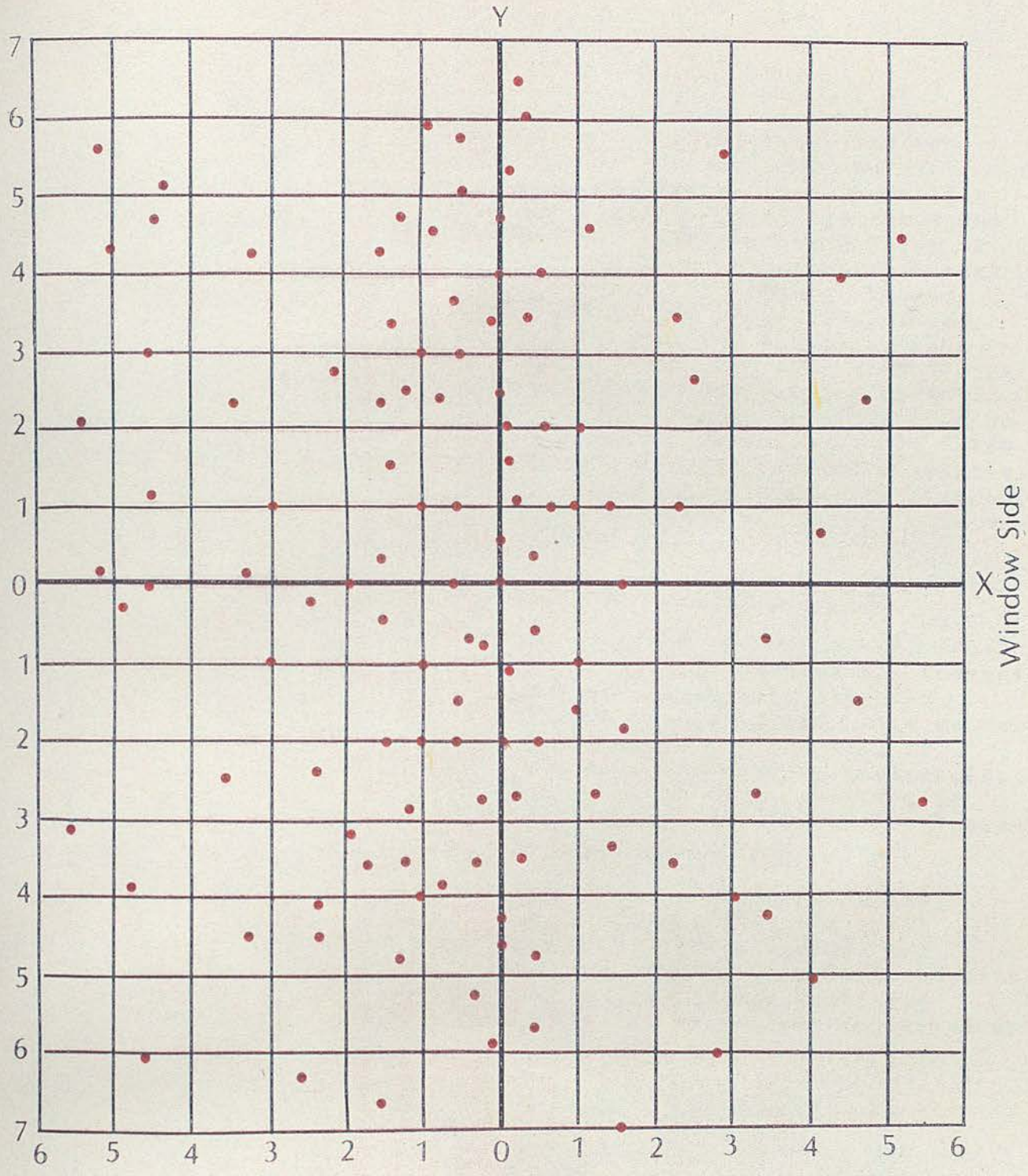


TABLE 4.2 PRESENT THE LOCATION OF THE SUBJECTS WHO DID NOT PREFER LOW CEILING

Table 4.1 illustrates the location of the subjects who indicated some dislike of the low ceiling, and Table 4.2 presents those who did not mind the low ceiling or did not have any strong feelings about ceiling height. These findings are supportive of the notion that the people sitting closer to centre axis become more conscious of the ceiling height. However, it must be noted that no statistical measurement was taken by the investigator and therefore no scientific validity is claimed. These findings are purely observational.

4.3.4.2.2 Colour Scheme

The topic of colour scheme provoked the most discussion. Comments made were generally directed towards usuage of off-white colours on the walls and the lack of colour in the working environment. Participants often referred to the mood of their office as "cold-boring - unexciting, etc."

Participants exhibited a high level of consciousness about environmental colouring, and it did not seem to be associated with age or sex. These tentative statements were later confirmed by Study-IIIB.

4.3.4.2.3 Floor-Covering

Carpeted floor covering was preferred almost by the majority. Comments were made that carpets make the space look more friendly, less noisy, warm, and gives a more luxurious and prestigious look.

4.3.4.2.4 Heating and Ventilation

There was no major complaint about this subject. However, some complaints were made about the noise created by the system.

4.3.4.2.5 General Layout

The layout of some of the open plan offices had symmetrical arrangements. An inquiry was made to the managers in order to find out the reasons for this. The management and control of the staff was considered to be the main reason. But, workers generally did not favour this arrangement and considered it to be unfriendly and uncomfortable. Casual comments were that they felt as if "they are being watched", or "they are passing an exam", or "feel too small and unimportant", or "too formal".

A small working space with a low partition was most preferred. However, single station work was more desirable. It was commented that low partitions provide a sense of privacy and give the chance for self identity and friendship with others, whereas in an open plan one feels the need for defending ones own territory. However, it was revealed during the interviews that younger employees were generally more conscious about the arrangements than were the older ones.

Generally a mid/small size arrangement with 4 to 5 persons in which each had their own work-station divided by low partitions was favoured.

4.3.4.2.6 Lighting

Lighting, surprisingly did not evoke much discussion. It was often mentioned that it did its function. However, it was considered to be unexciting and boring by the majority. They were asked how they would have arranged the lighting themselves.

Suggestions were made to:

1) Change the look of the grid system on the ceiling.

2) Have less general lighting and more localised lighting.

3) Have warmer colour rendition to complement complexion.

4.3.4.2.7 View Through Window

Almost all the participants interviewed believed that a view to the outside was important while pleasant views were obviously preferred. The main concern was "being able to see outside". To be able to communicate with the outside world, especially when they were depressed, or even just to be able to see the weather change was considered critically important. Windowless offices, or offices with clear story windows (ie. windows above the view height) were considered to cause a feeling of "being trapped".

4.3.4.3 Discussion and Conclusion

The success of the organization depends upon a complex network of many factors. Adaptability, stability and identifiability may be regarded as the three key aspects of an organization which enables it to survive. Canter[8] argues that in order to obviate conflict and lack of communication, it is necessary for the organization to have a degree of "adaptability" within its structure, which in turn will depend upon the patterns of communication which take place within it. "This need for adaptability conflicts to some degree with the need for 'identity'. If it is necessary to identify the role a person has in order to facilitate communication, then variations in that role over time due

to adaptation will cause confusion. A balance must therefore be found between these two in order to give the organization some 'stability'.

One further thing necesary for an organization to exist and continue existing is that workers must derive some satisfaction from being functioning members of that organization. Therefore, the forth key aspect for an organization is the level of 'satisfaction' of the workers.

Studies on job satisfaction show that worker satisfaction is related to several factors.[16 - 17]

1) The job itself. The work in which the person is engaged. This relates to how interesting the job is and to what degree the person feels that it is the right job for him.

2) Co-workers. The persons with whom the person has frequent contact. The degree in which they communicate, share interests, finds them understanding and friendly.

3) Supervision. The person to whom the worker is immediately responsible, the supervisor, is often considered to be the leader of the team who needs to very delicately control the pattern of interactions between the team. In a study by Morse[7], it was found that job satisfaction and productivity were often linked with the supervisor's communication with others.

4) The orgainzation. The public image of its product has a great deal of influence on the workers attitude towards the organization.

5) Financial reward. Wages and/or salary, bonuses and perquisites.

6) Working conditions. Studies[18-5] show that working conditions are an identifiable aspect of overall worker satisfaction. Working conditions include a wide range of things from tea breaks, to the decor of the working environment. However, it has been illustrated[12] that physical environment can be identified as a separate aspect of job satisfaction.

7,8 & 9) Satisfaction and productivity. Status and self-fulfilment are also related to job satisfaction.

These findings illustrate the psychological processes underlying job satisfaction, and hence motivation needs to be created for the members in order for the organization to survive.

The study reported here covers an overview of only one aspect of job satisfaction. But, it does contribute an equally important one. It helps to demonstrate the level of conscious awareness with respect to the physical environment and the relative lack of its provision. The comments reported here are of course impressionistic, however they provide an overview of the attitudes of staff in office interiors. Thus, no scientific validity is claimed by the investigator for the data obtained from this section. Due to the informal nature of the interviews, the questions were not always the same and the emphasis of interest varied with every group.

Drawing conclusions from this study is complicated due to the difference in materials derived from interviews and also the

informal nature of the interview. The value of this study rests, however, upon the fact that the interviews provided an exploratory background to more comprehensive study and indicates the direction this research should take. On a more general level, this study has provided a background for the interpretation of the investigations reported in the following chapters.

4.3.5 Case Study III-B Questionnaire Survey For Evaluation of Visual Environment

4.3.5.1 Objective

This study attempted to provide more validation (or less) for the information derived during the time of exploratory interviews through empirical studies. Further more, to establish which physical stimuli in an office interior is likely to provoke most attention, and also to formulate investigations concerning those physical stimuli, hence establishing the direction of the research.

4.3.5.2 Construction of the Questionnaire

Construction of the questionnaire was directed primarily to gathering information about the visual environment and obtaining personal data concerning the respondant, ie. sex and age, (ref. to Appendix - IIB).

Having established the instrument covering the desired range of topics, it then remained to decide on the form of questioning. The most fundamental issue to decide was the manner of questioning. In other words, whether to question directly and explicity or indirectly from which attitudes and opinions could later be deducted.

However, the method of direct questioning was preferred by the investigator. Each question was expressed with multiple alternatives in front ranging for positive, neutral and negative responses. Verbal scales were preferred to numerical ones for the sake of clarity. This, of course, gives a rough scale.

Having obtained the draft from the questionnaire a pre-test was run in order to test its clarity following which necessary modifications were made.

An attempt was made throughout both studies to avoid raising the suspicion in the mind of the respondant that she/he was being used as an experimental subject rather than a source of information.

4.3.5.3 Procedure

The questionnaires were distributed among the staff immediately after the informal interview. Each questionnaire contained a stamped envelope addressed to the investigator. This was due to the limitation on time available to the participants. In order to allay possible suspicion in the minds of the resondants that they were being used as experimental subjects rather than a source of information, an explanatory letter addressed to the participants and signed by the investigator was enclosed in the envelope containing the questionnaire. (Ref. to App. II-B for questionnarie).

4.3.5.4 Analysis of Data

Two hundred and seventy-eight of the three hundred questionnairs were returned. A summary of the data which formed the basis of analysis is presented

in the following tables. X^2 were used for some of the responses to the questionnaire in order to examine sex and age differences. These calculations are enclosed in App. - IIC. Furthermore a histogram of these tables is provided to visually illustrate the responses.

AGE	MALE	FEMALE	TOTAL
A 18-35	73	81	154
B 36-55	59	65	124
TOTAL	132	146	278

Table 4.3 - Number of Respondents In Each Age and Sex Group.

Question 1: Do you feel that a pleasant visual environment in your working space can be influential on the performance of the job you are doing?
1 - Important, 2 - Not So Important, 3 - Not Important

Analysis:

X^2 was employed in order to seek any differences which may exist among the subjects of different sex and age.

The analysis showed no statistical difference between the male subjects of the two different age group at .05 (showed sig. at .30), and the females of the two age groups. Further analysis was made to compare males and females of the same age group. No significant differences were found between the male and female at .05 level. However, a significant difference was observed between males and females of age 36 - 55 at .10 level.

However, since no significance was found between the participants at .05 and below, the responses were put together for further analysis. Table 4.4 to 4.6 represent the response to Question 1.

VERBAL SCALE	MALE		FEMALE		TOTAL
	18-35	36-55	18-35	36-55	
1	32	21	43	35	131
2	24	28	21	16	89
3	17	10	17	14	58
TOTAL	73	59	81	65	278

Table 4.4 - Responses to Question 1.

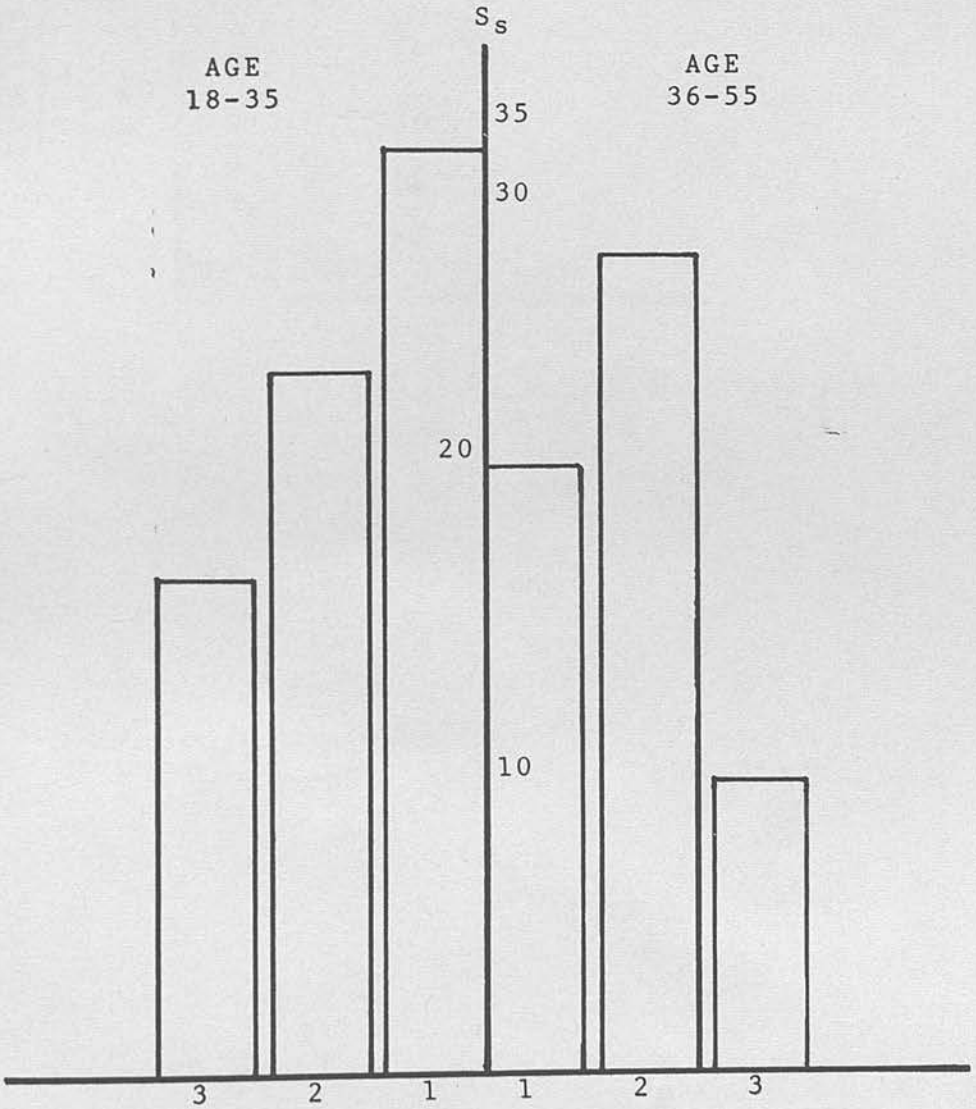


Table 4.5 - Histogram Comparing The Male Subjects

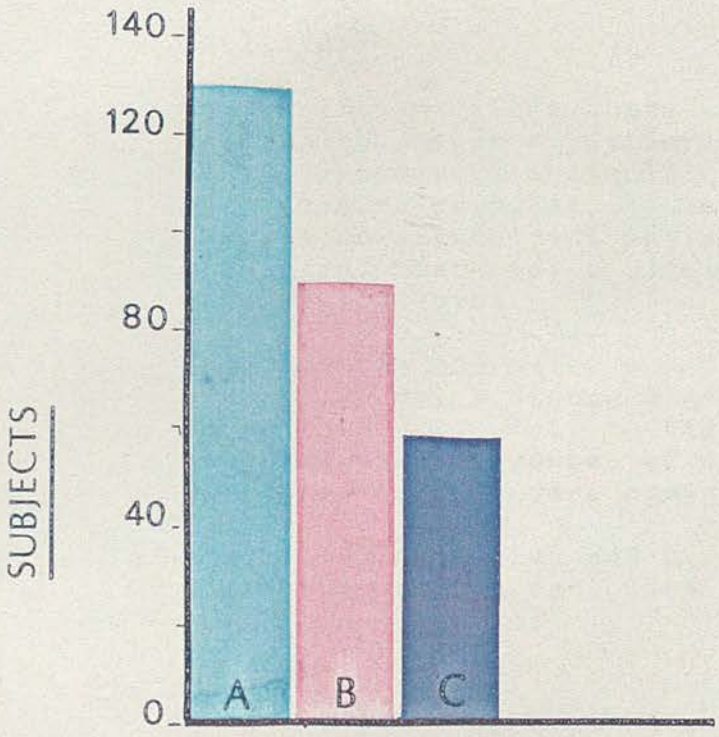


TABLE 4.6 HISTOGRAM ILLUSTRATING THE TOTAL RESPONSES TO Q-1

A – IMPORTANT
B – NOT SO IMPORTANT
C – NOT IMPORTANT

Question 2: These are the list of physical stimuli that you have in your working environment. Please put this list in rank order based on what you feel is more important and needs more attention. 1 - Ceiling Height, 2 - Colour Scheme, 3 - Furniture Layout, 4 - Light, 5 - View to Outside.

Analysis:

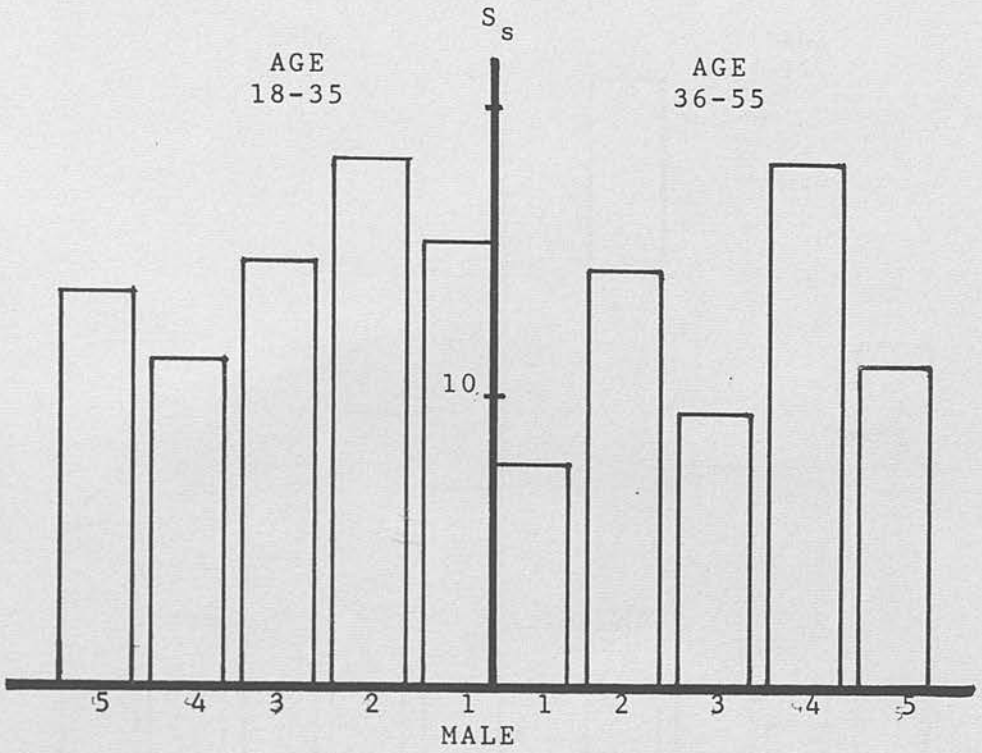
No significant differences were detected between the males of different age group at .05. However, a significant difference was observed at .30 level. As for females no significant was observed at .05, but again, there was a significant difference at .10 level.

In comparing the males and females of the younger group, a strong significance was found (at .02). But, no significance was observed when responses of older groups of males and females were compared.

The following tables and histograms illustrate the various responses to Question 2.

PHYSICAL STIMULI	MALE		FEMALE		TOTAL
	18-35	36-55	18-35	36-55	
1	15	7	6	8	36
2	18	14	31	18	81
3	16	10	16	11	53
4	11	17	7	15	50
5	13	11	21	13	58
TOTAL	73	50	81	65	278

Table 4.7 - Responses to Question 2.



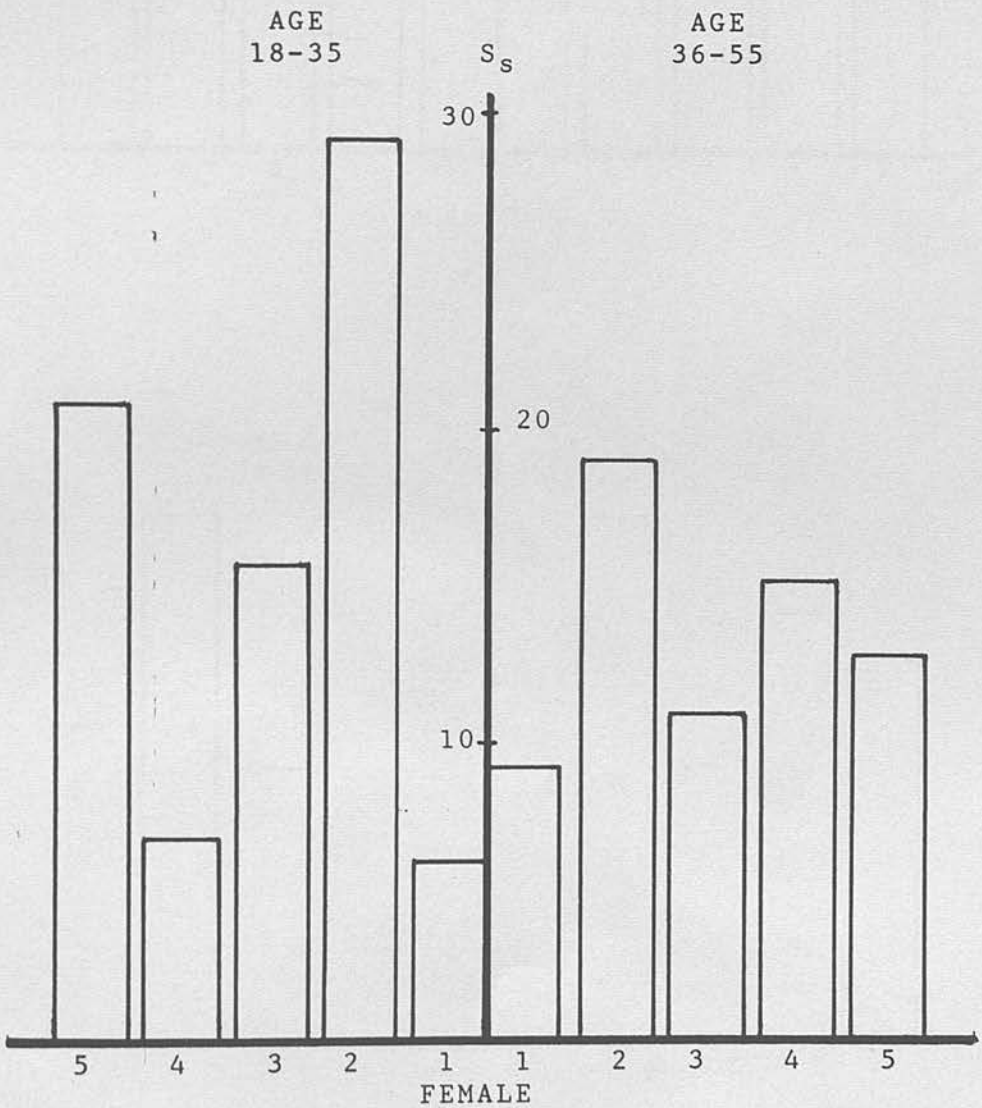
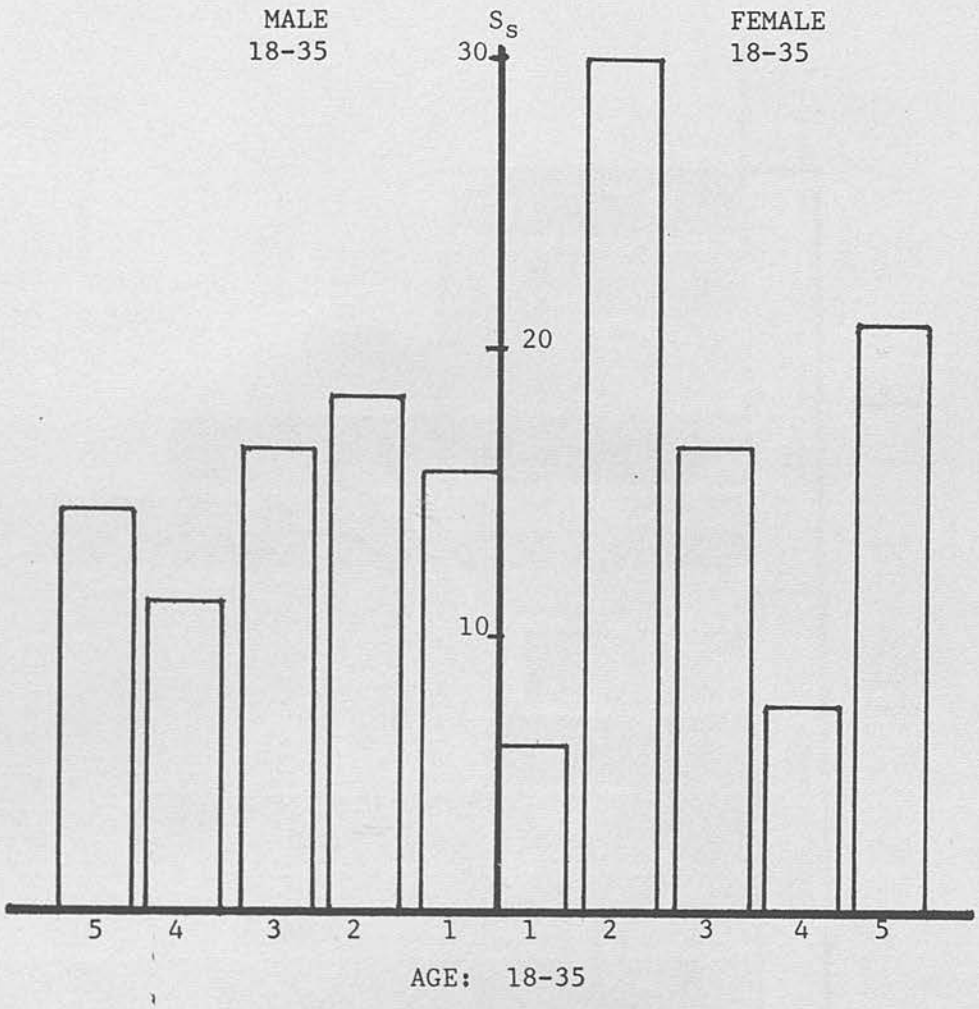


Table 4.8 - Histogram Comparing the Females and Males of the Two Age Groups



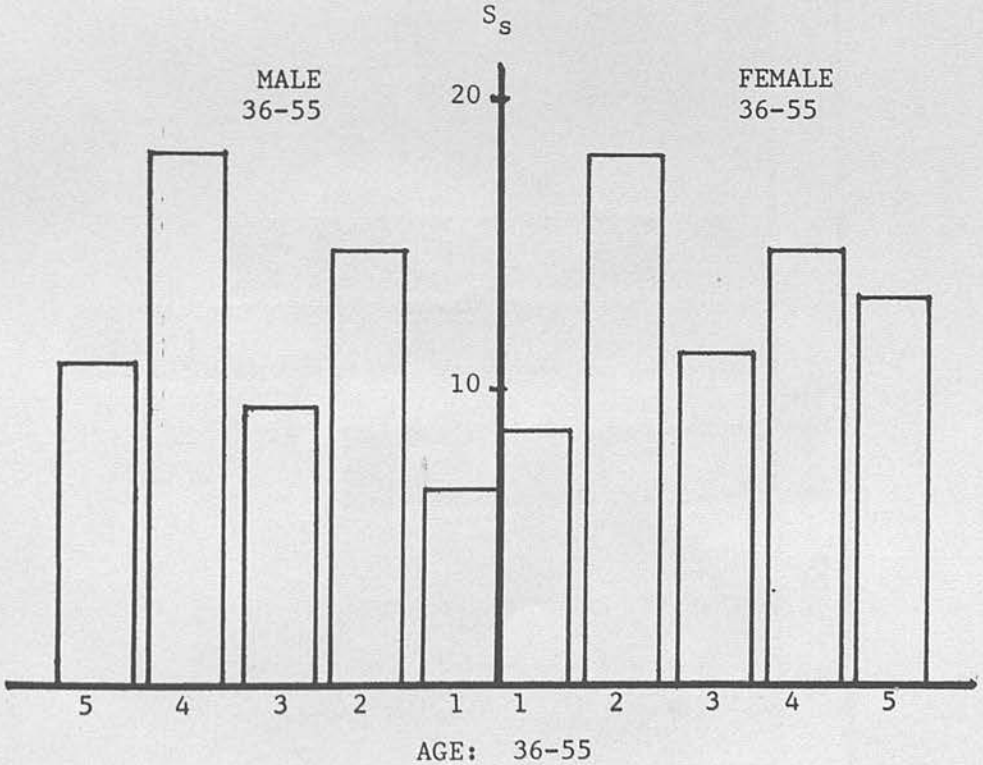


Table 4.9 - Histogram Comparing Male and Female Responses of the Same Age Group.

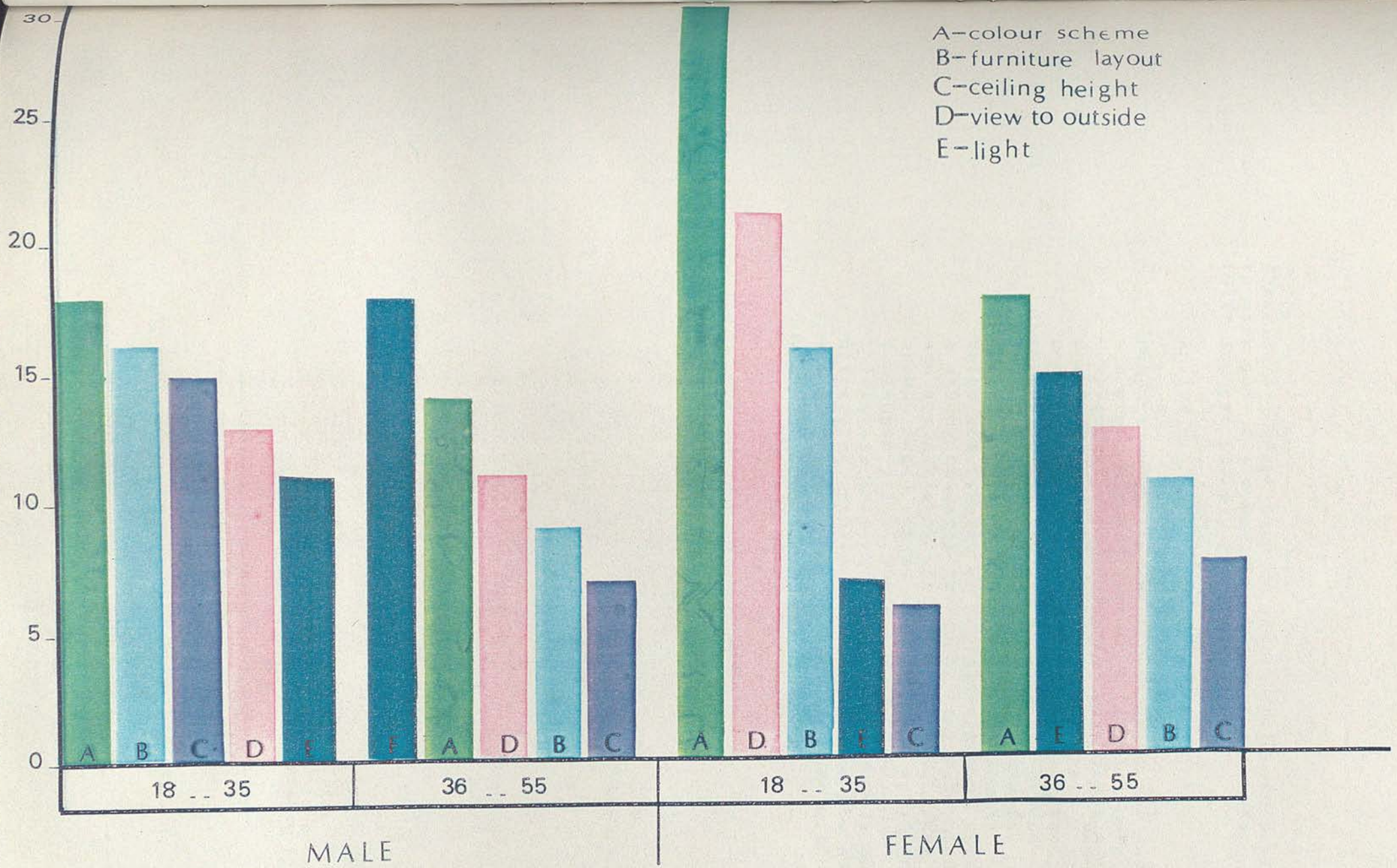


TABLE 4.10 PRESENT THE SUMMARY OF THE RESPONSE GATHERED FROM Q-2

Question 3: Which type of office would you prefer to work in? 1 - Open-plan, 2 - Semi-open plan (With low-partition), 3 - Conventional.

Analysis:

Comparison of females and males of the same age group did not reveal any significance. However, strong differences were revealed when males of the two age groups were compared (at .10 levels). Similarly the comparison of females of both age groups showed a significant difference between younger and older groups (at .05 level). Males and females of the older groups showed a strong tendency to favour semi-open plan and conventional offices. Whereas, young groups (both sexes) preferred open-plan and semi-open plan. The following tables illustrate this analysis. As there was no difference between the two sexes of the same age group, the responses of each age group were put together.

VERBAL SCALES	MALE		FEMALE		TOTAL
	18-35	36-55	18-35	36-55	
1	26	15	26	13	80
2	29	21	34	23	107
3	18	23	21	29	91
TOTAL	73	59	81	65	278

Table 4.11- Responses to Question 3.

VERBAL SCALES	18-35	36-55	TOTAL
1	52	28	80
2	63	44	107
3	39	52	91
TOTAL	154	124	278

Table 4.12 - Responses to Question 3.

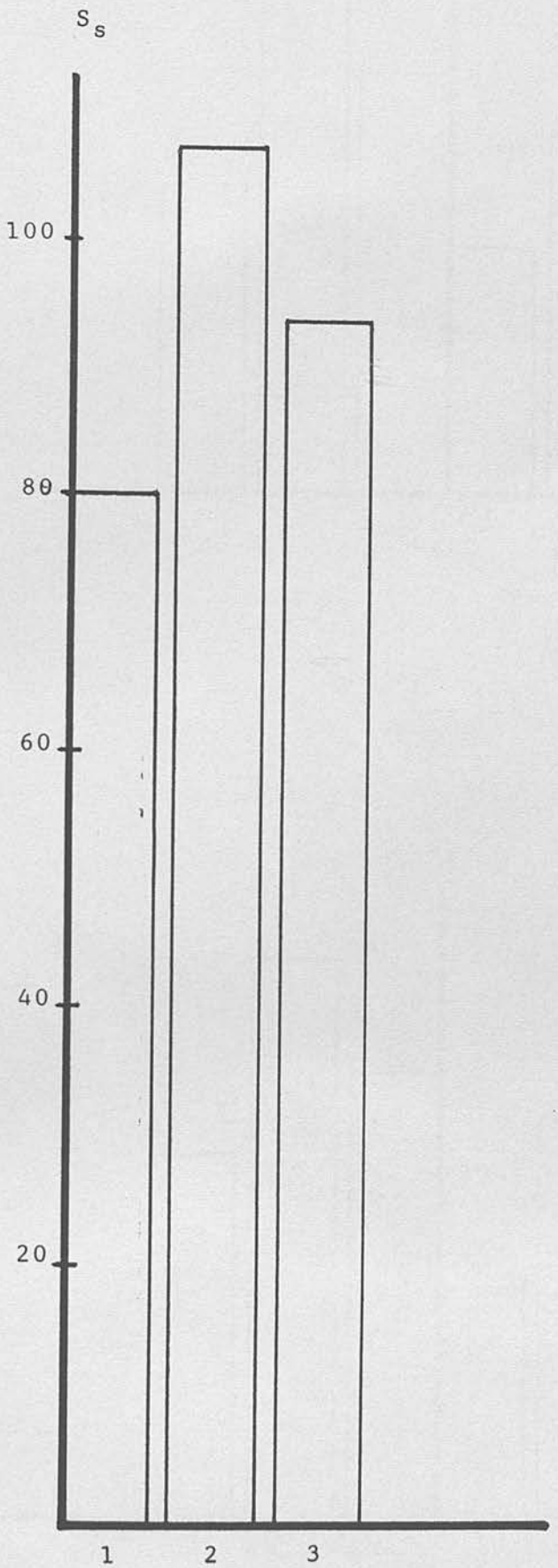
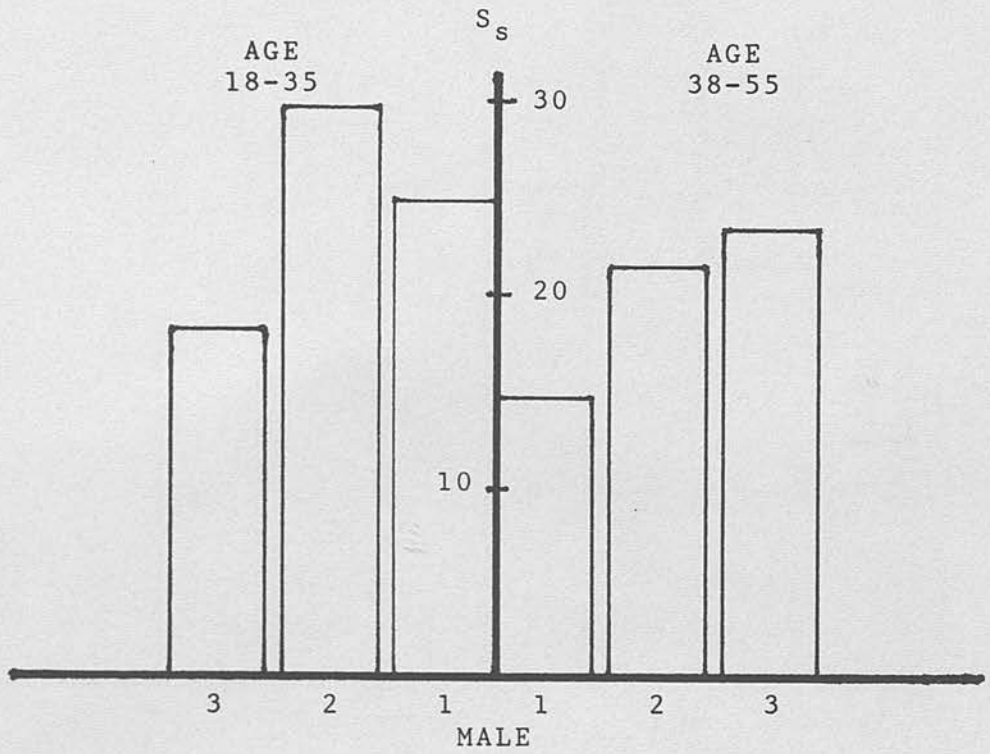


Table 4.13 - Histogram Illustrated The Total Responses to Question 3.



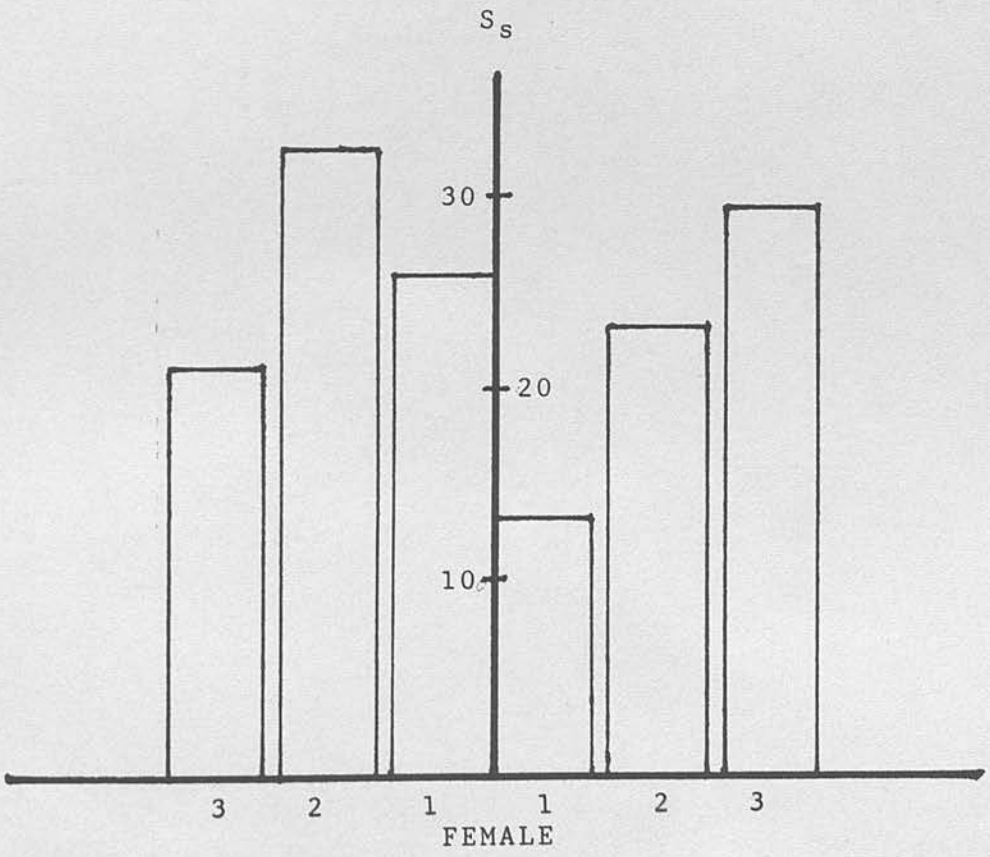
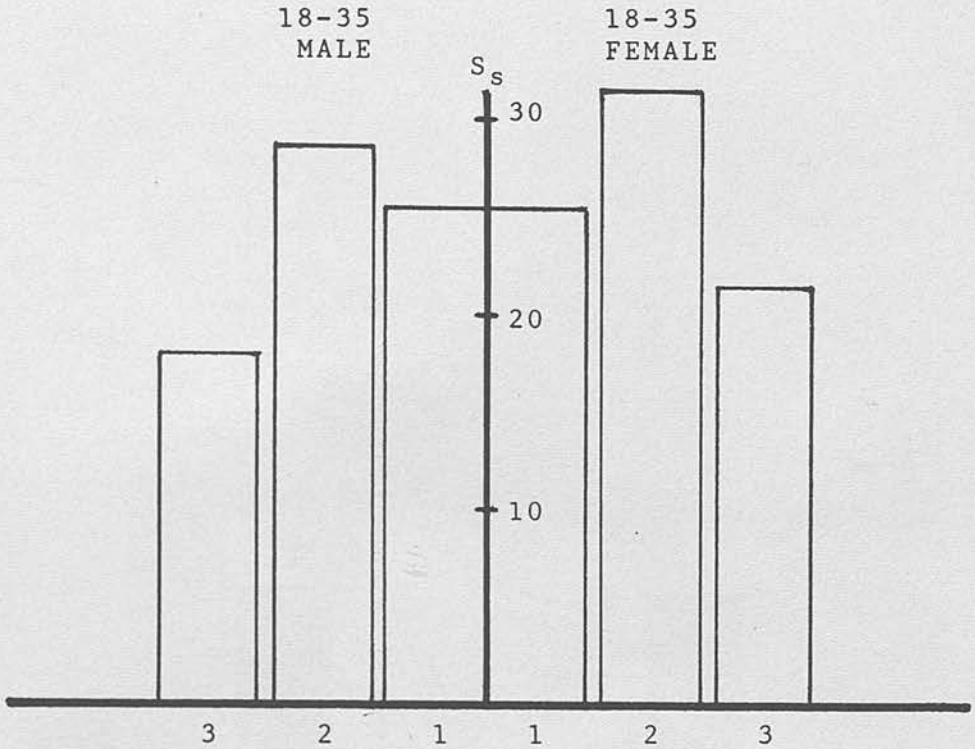


Table 4.14 - Compares The Responses Gathered From Males and Females Based on Age Groupings.



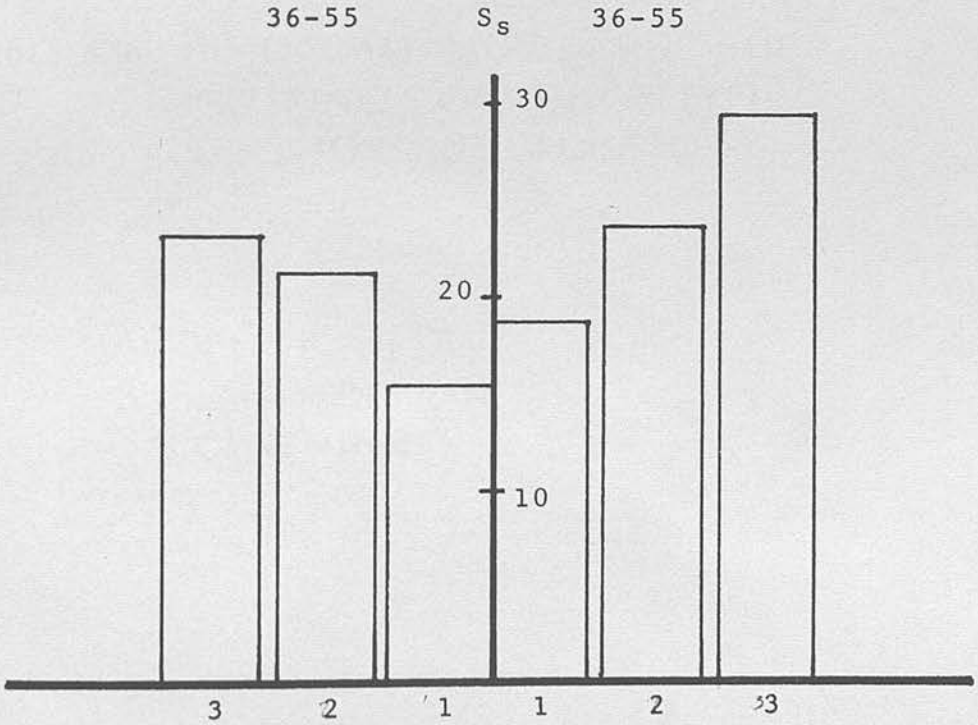


Table 4.15 - Histogram Illustrating The Comparison of Male and Female Subjects in Each Age Group.

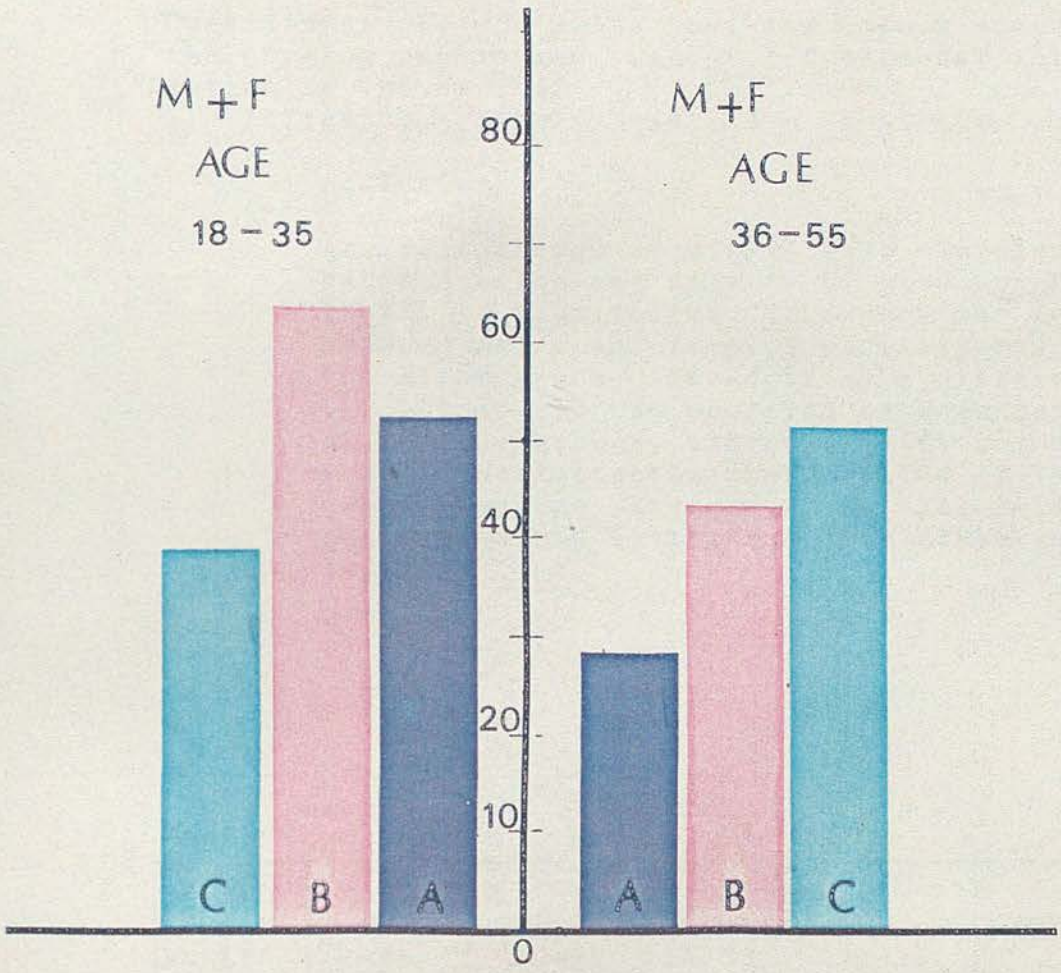


TABLE 4.16 HISTOGRAM ILLUSTRATING THE PREFERENCES OF OFFICE TYPE BASED ON AGE GROUP Q–3

A–OPEN PLAN
B–SEMI OPEN PLAN
C–CONVENTIONAL

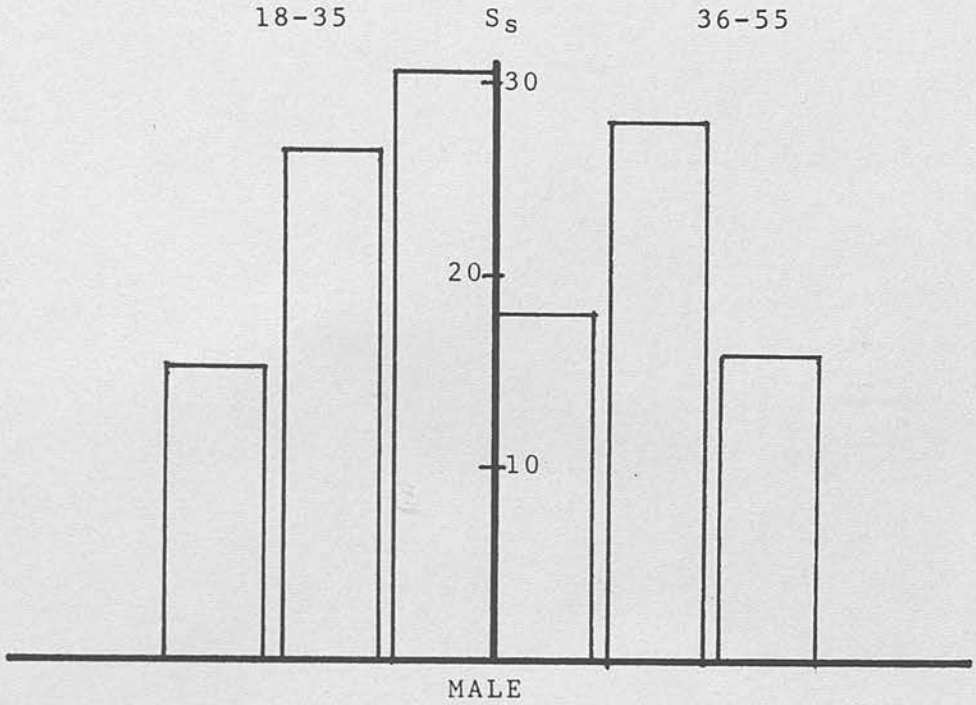
Question 4: Do you think that the colour scheme of the working environment can affect personal interaction in the office?
1 - Affect, 2 - Might Affect, 3 - No Affect

Analysis:

Analysis showed no significant differences between males and females of ages between 18-35. A significant difference was found between males and females participants of the older group. In addition a difference (at .01 level) was observed between males of the two groups, and no significant difference was detected when females of the two age groups were compared. The following tables and histograms illustrate these analyses.

VERBAL SCALE	MALE		FEMALE		TOTAL
	18-35	36-55	18-35	36-55	
1	31	17	43	33	124
2	27	28	22	21	98
3	15	14	16	11	56
TOTAL	73	59	81	65	278

Table 4.17 - Presenting the Responses to Question 4.



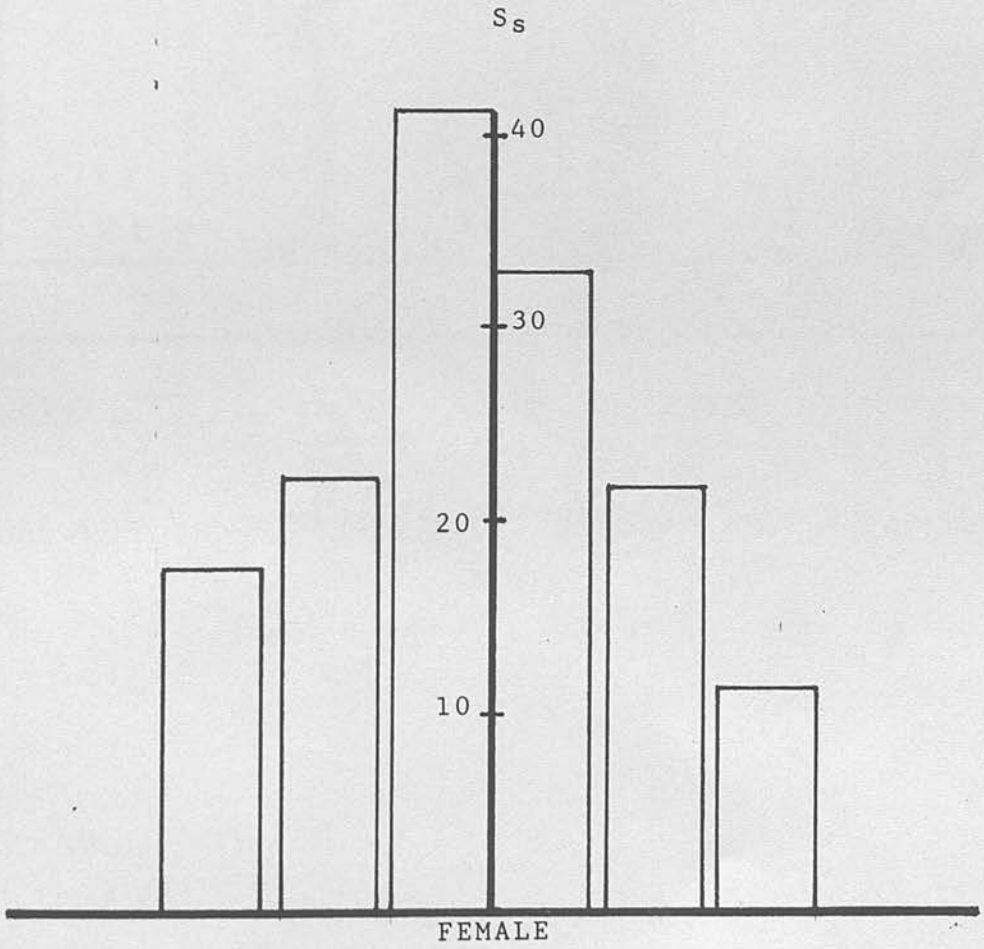


Table 4.18 - Histogram Comparing the Two Age Groups For Each Sex

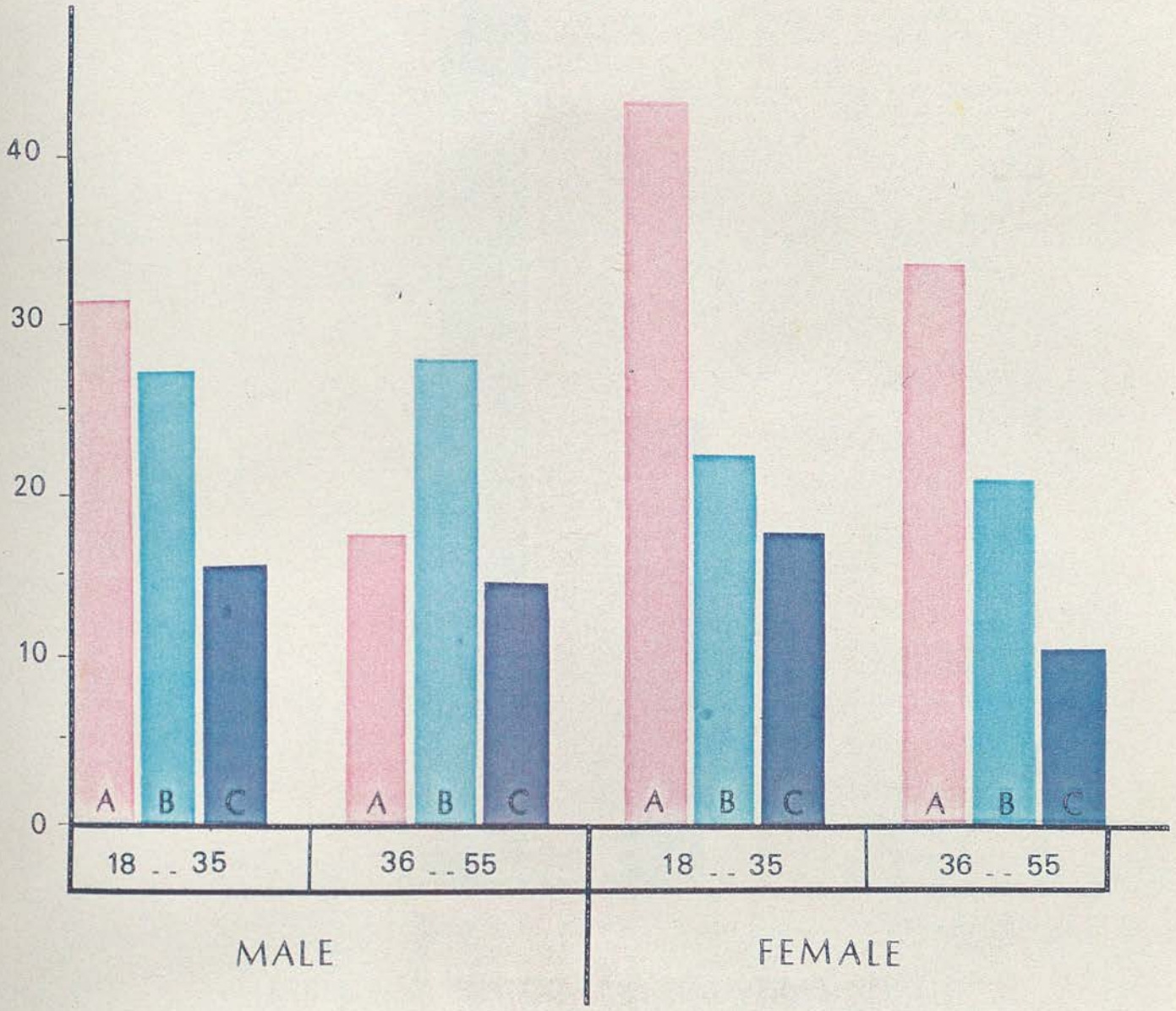


TABLE 4.19 HISTOGRAM ILLUSTRATING THE

TOTAL RESPONSES TO Q-4

A- AFFECT
B- MIGHT AFFECT
C- NO AFFECT

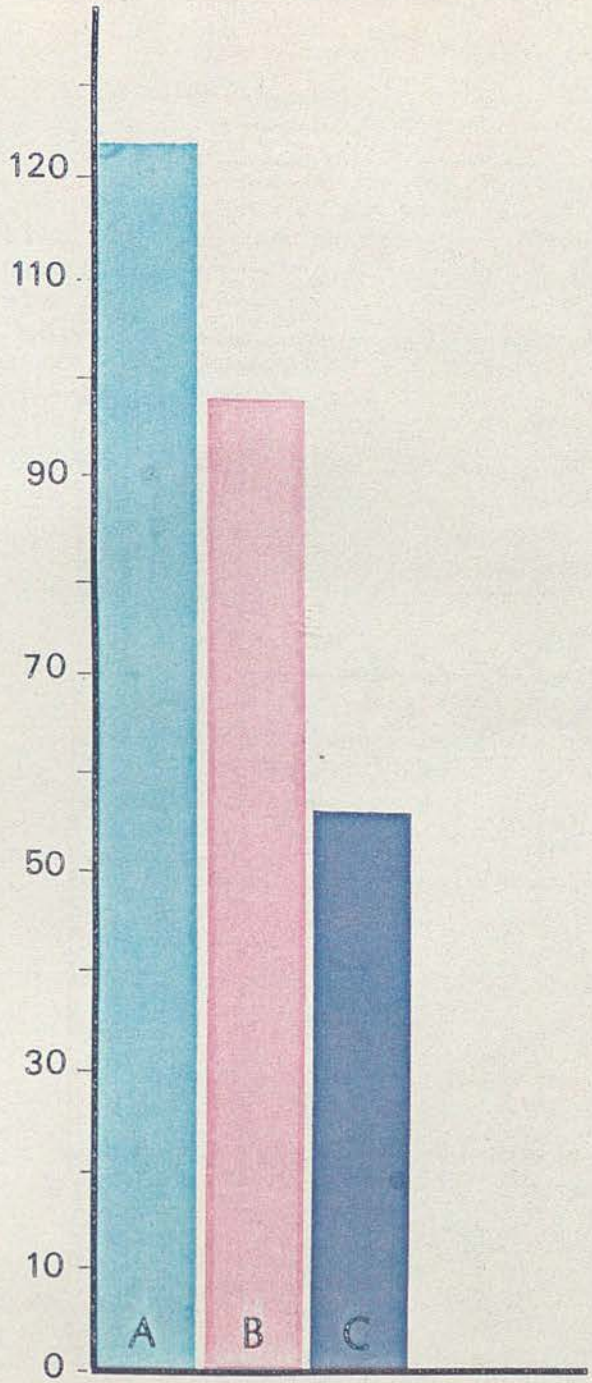


TABLE 4.20 HISTOGRAM ILLUSTRATING THE TOTAL RESPONSES TO Q-4

A- AFFECT
B- MIGHT AFFECT
C- NO AFFECT

Question 5: Do you think that the furniture layout in an office can affect the personal interaction of the staff?
1 - More Friendly, 2 - Might Affect, 3 - No Affect

Analysis:

No significiant differences were found when various groups of sex and age of participants were compared. The responses are put together and are shown in the following tables.

Scale	Male		Female		Total
Age	18-35	36-55	18-35	36-55	
1	32	25	43	34	101
2	24	18	21	16	79
3	17	16	17	15	65
Total	73	59	81	65	278

Table 4.21 - Presents the Responses to Question 5.

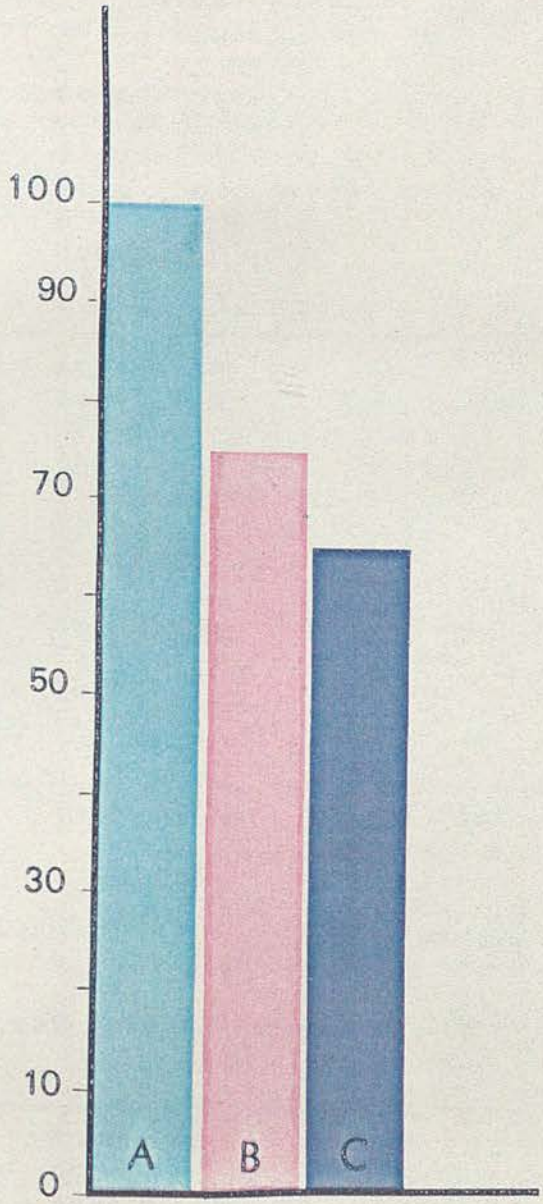


TABLE 4.22 HISTOGRAM ILLUSTRATING THE TOTAL RESPONSES TO Q-5

A- MORE FRIENDLY
B- MIGHT AFFECT
C- NO AFFECT

Question 6: Describe your ideal working environment by using descriptive adjectives.

Responses:

A great number of adjectives were gathered from the question above. The table below presents these adjectives in alpahbetical order.

Appealing	Fresh	Masculine
Beautiful	Handsome	Modern
Bright	Homely	Pleasant
Cheerful	Happy	Quiet
Comfortable	Harmonious	Relaxed
Dynamic	Imaginative	Sunny
Distinct	Informal	Safe
Elegant	Inspiring	Secure
Exciting	Interesting	Serious
Feminine	Intimate	Spacious
Formal	Light	Stylish
Friendly	Large	Stimulating
		Welcoming

Table 4.23 - Descriptive Adjectives Elicited From Question 6.

Question 7: Describe your present working environment using descriptive adjectives.

Responses are shown as Table 4.24.

Adequate	Exciting	Quiet
Acceptable	Formal	Satisfactory
Anxious	Friendly	Spacious
Beautiful	Free	Suitable
Bad	Good	Stimulating
Boring	Gloomy	Simple
Cold	Happy	Safe
Controlled	Hard	Traditional
Cramped	Harmonious	Ugly
Clean	Informal	Warm
Cluttered	Intimate	
Dark	Light	
Dull	Noisy	
Dominant	Pleasant	
Defensive	Poor	

Table 4.24 - Descriptive Adjectives Elicited From Question 7.

4.3.5.5 Discussion

Question 1: Slight differences were found in the responses gathered from male participants of the two age groups. The majority of the younger group were more positive in believing that a pleasant visual environment could affect the performance of the job, whereas the majority of the older group expressed the view that a pleasant environment may be a factor influencing the performance of the job.

Female participants of both age groups were positive in relating the visual environment, to the performance of their job. While these resonses may illustrate that the female participants might have been more conscious of their environment than were the male participants, a great degree of conscious awareness about the environment has been illustrated by the responses to this question. This fact has been reinforced by the responses gathered from the following questions.

Question 2: Male and female responded somewhat differently. Colour schemes, furniture layouts, and the ceiling height seemed to be the ranked order of the first three important physical stimuli in the environment selected by younger male participants, whereas the older male participants voted for light, colour and the view to the outside.

Younger female participants showed more concern about colour, view to outside and furniture layout, whereas female subjects of age between 36-55 voted for light, colour and the view to outside.

It seems from the analysis that the younger groups of participants were more concerned about colour, whereas the male and female particpants of age 36-55 put more importance on the lighting.

The view to outside concerned more female participants than male subjects. However, from all the different responses gathered, it is apparent that most participants shared the importance of light, colour and furniture layout in their working environment.

Question 3: Although the semi-open plan was voted as the favourite, there appeared a clear indication on the part of the older group of participants for a conventional office type. This result is in accord with the results of the informal interviews conducted prior to the questionnaire. Noise, lack of status, prestige and many other personal factors migh be the reasons attributed to the above responses.

Questions 4 and 5: Responses to both questions illustrate positive reaction to the effect of colour and furniture layout on the personal interaction between staff.

Questions 6 and 7. Gathered descriptive adjectives illustrate a general lack of satisfaction with the working environment and a description of the atmosphere in which the staff would prefer to work.

4.4 Conclusion

In general, the studies reported here show a great deal of conscious awareness of the workers to their working environment. Colour, light and furniture layout do seem to be influential factors based on the participants' experience.

These findings formed the basis of a series of experiments focusing on the effects and interaction of colour, furniture layout and light on the working environment and are reported in the following chapters.

4.5 Summary

This chapter discusses the importance of understanding the function of the interior and the needs of its users prior to establishment of design.

As this research concentrates on office-interiors, two case studies were arranged. The objectives were 1) a general exploration and understanding of the users' expectation of their working environment, and 2) to establish the important aspects of their visual environment.

The result of these studies indicated a high level of conscious awareness of the visual aspects of work space and the current lack of attention to its provision. Information elicited from these studies was discussed and the main area of research was established.

CHAPTER FIVE

CHAPTER FIVE - SURVEY OF COLOUR PREFERENCE IN OFFICE INTERIORS

A Survey of Colour Preference In Office Interiors

5.1 Introduction

Following the preceding study reported in Chapter IV. The present studies were formulated for an exploratory survey of colour preference in office interiors. The surveys made were for two types of offices, the semi-open plan and the conventional interior, these being favoured in earlier interviews over the open plan interior arrangement, (see Chapter IV). Public offices of contemporary style in Edinburgh-Scotland were visited for this study.

5.2 Purpose of Study

The preceding chapter illustrates the workers' concern about colour in their working environment. Comments made to the investigator during those informal interviews led to the belief that a study of colour preference in office interiors might have some merit in understanding the subjective preference exhibited and thus, assist us in providing some insight into the needs and expectations that office workers have about their visual environment.

5.3 Case Study IV - Colour Preference For Conventional Office Interiors

5.3.1 - Procedure

Seventy-five office workers (39 Female and 36 Male), age 20-35, participated in this study. While no particular attempt was made to survey the colour preference of only one age group, this turned out to be the case as the investigator was only allowed to interview volunteers, all of whom happened to be younger employees. The visits were not arranged in advance but by simply making a request upon arrival at the office.

Each participant was first asked to imagine that he/she was going to choose the colour scheme for his/her office (mainly their own working environment). The office employees were then asked to select a colour for the floor. Upon the selection of hue, he was then shown the portion of the Munsell Colour Atlas containing the various chroma and value of that hue in order to further facilitate the selection of a

specific colour with all its properties (see Appendix III-A). This systematic procedure was repeated for walls, ceiling and furniture. Tables 1 and 2 (Appendix III-B) presents the colour preferences from which the conclusions were drawn by analysis.

5.3.2 Analysis

First, a separate analysis was done for the preferred colour for ceiling, floor, walls and furniture. $X^{2(1)}$ was made to observe the differences that might exist between male and female participants (Appendix III-C). Then, the data was put together for further analysis if no significant difference was found.

A tabulation of the first, second and often third choices as made for each of the major physical surfaces and for the furniture. These tables contained participants' choice of hue, value and colour temperature.

Further analysis was also made in order to find the most popular colour combination. This was done by comparing the first, second and third choices of the colour combination used. The first stage of analysis is presented in Appendix III-C; The second stage in Tables 5.1 - 5.12, and the third in Tables 5.13 - 5.18.

For the sake of simplicity red, orange and yellow; yellow-green, green and green-blue and finally blue and blue purple were grouped together.

5.3.2.1 Second Stage of Analysis

A - Ceiling:

Responses from male and female participants regarding the preferred colour for ceiling were compared using X^2. No significant difference was shown at .05 level, (A significant difference was detected at .10 level). However, since no significance was shown at .05, all the data was put together for final analysis. The following tables include the data gathered from male and female subjects and the final tabulation of the responses.

CEILING/HUE		
H	1 WHITE	2 R ,Y, R, R
S_s	18	13

CEILING/VALUE		
V	8 & 9	7
S_s	27	7

CELING/COLOUR TEMPERATURE		
T	NEUTRAL	WARM
S_s	18	13

Table 5.1 - Responses From Male Subjects

CEILING/HUE		
H	1 Y.,Y.R.,R	2 WHITE
S_s	23	12

CEILING/VALUE		
V	1 8 & 9	2 7
S_s	28	8

CEILING/COLOUR TEMPERATURE		
T	1 WARM	2 NEUTRAL
S_s	23	12

Table 5.2 - Responses From Female Subjects

CEILING/HUE		
H	1 Y., Y.R., R.	2 WHITE
S_s	36	30

CEILILNG/VALUE		
V	1 8 & 9	2 7
S_s	55	15

CEILING/COLOUR TEMPERATURE		
T	1 WARM	2 COLD & NEUT.
S_s	41	25

TABLE 5.3 - Total Responses To The Colour Preferred For Ceiling

B - Floor:

Similar analysis was made using the X^2 method of comparison between the responses gathered from male and female subjects. No significant difference was observed at .05 level. However, a significant difference was observed at .20. Nevertheless, the responses were put together for the conclusion. The following tables present the responses from individual groups and, also, the total responses.

FLOOR/HUE			
H	1 GREEN Y.G.G.G.B.	2 BLUE B.P.B.	3 BROWN Y.,Y.R.,R.
S_s	15	11	10

FLOOR/HUE			
V	4 & 5	3 & BELOW	6 & BELOW
S_s	19	15	2

FLOOR/COLOUR TEMPERATURE		
T	COLD	WARM
S_s	26	10

Table 5.4 - Colour Preferred By Male Participants

FLOOR/HUE			
H	1 BROWN Y.,Y.R.,R.	2 GREEN Y.G.,G.G.B.	3 BLUE B.BP.
S_s	18	12	9

FLOOR/VALUE			
V	4 & 5	3 & BELOW	6 & ABOVE
S_s	23	12	4

FLOOR/COLOUR TEMPERATURE		
T	WARM	COLD
S_s	18	21

Table 5.5 - Colour Preferred By Female Participants

FLOOR/HUE			
H	1 BROWN	2 GREEN	3 BLUE
S_s	28	27	20

FLOOR/VALUE		
V	4 & 5	3 & BELOW
S_s	42	27

FLOOR/COLOUR TEMPERATURE		
T	WARM	COLD
S_s	28	47

Table 5.6 - Total Response To Preferred Colour Of Floor

C - Wall

A significant level of difference at .20 was observed again between male and female participants. However, since the significance level was less than .05, the data was put together for final analysis. Following tables show the analysis.

WALL/HUE			
H	1 Y.,Y.R.,R	2 WHITE	3 G.,B.
S_s	19	12	6

WALL/VALUE		
V	8 & 9	7
S_s	27	5

COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	19	18

Table 5.7 - Responses From Male Participants

WALL/HUE			
HUE	1 Y.Y.R.R.	2 G. & B	3 WHITE
S	28	6	5

WALL/VALUE		
V	8 & 9	7 & 6
S_s	20	14

WALL/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	28	11

Table 5.8 - Responses From Female Participants

WALL/HUE			
H	R.Y.R.Y.	WHITE	G.&B.
S_s	47	17	12

WALL/VALUE		
V	8 & 9	7
S_s	47	19

WALL/TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	47	29

Table 5.9 - Total Responses To Preferred Colour of Wall

D - Furniture:

No significance was found when male and female responses were compared. Observation of Table 1 and 2, APP. III-B shows some dissimilarity between the two groups of subjects for the preferred value for furniture. X^2 was used for comparison, and a significant difference at .05 level was observed. Therefore, only the data for hue and colour temperature were put together for final analysis.

FURNITURE/HUE			
H	1 Y.R,R,Y	2 NEUTRAL	3 B & G
S_s	22	8	7

FURNITURE/VALUE			
V	7 & ABOVE	5 & 6	3 & 4
S_s	10	5	17

FURNITURE/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	22	15

Table 5.10 - Colour Preferred By Male Participants

FURNITURE/HUE			
H	Y,Y.R,R	WHITE	B & G
S_s	20	13	6

FURNITURE/VALUE			
V	7 & ABOVE	6 & 5	4 & 3
S_s	14	11	10

FURNITURE/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	20	19

Table 5.11 - Colour Preferred By Female Participants

FURNITURE/HUE			
H.	Y.R,Y.R	WHITE	B & G
S_s	42	21	13

FURNITURE/TEMPERATURE			
T	WARM	COLD	NEUTRAL
S_s	42	13	30

Table 5.12 - Total Responses For The Preferred Colour of Furniture

5.3.2.2 Third Stage of Analysis

Comparison of the first, second and third choice of preferred colours for ceiling, floor, wall, and furniture were made and are presented in the following tables:

HUE			
CEILING / FLOOR		CEILING/HUE	
		Y.,Y.R.,R.	WHITE
FLOOR	Browns	24	5
	Greens	13	11
	Blue	3	14

CEILING / WALL		CEILING/HUE	
		Y.,Y.R.,R.	WHITE
WALL	Y.-R.	27	12
	White	2	13
	B.-G.	5	3

CEILING / FURNITURE		CEILING/HUE	
		Y.,Y.R.,R.	WHITE
FURNITURE	Y.-R.	28	12
	W. & N.	4	13
	B. G.	3	6

Table 5.13 - Hue Preferred When Ceiling Hue Compared With Floor, Wall and Furniture

VALUE			
CEILING / FLOOR		CEILING	
		8 & 9	7
FLOOR	4 & 5	37	7
	3 & 2	20	6
	6 & ABOVE	1	0

CEILING / WALL		CEILING	
		8 & 9	7
WALL	8 & 9	41	9
	7	10	6

CEILING / FURNITURE		CEILING	
		8 & 9	7
FURNITURE (FEMALE)	7 & ABOVE	12	2
	6 & 5	8	4
	4 & 3	7	2

CEILING / FURNITURE		CEILING	
		8 & 9	7
FURNITURE (MALE)	3 & 4	15	4
	7 & ABOVE	6	1
	5 & 6	4	0

Table 5.14 - Value Preferred When Ceiling Value Is Compared With Floor, Wall and Furniture

FLOOR / WALL		FLOOR/HUE		
		BROWN	GREEN	BLUE
WALL	Y.-R.	27	13	7
	WHITE	2	7	10
	C. & B.	0	9	4

FLOOR / FURNITURE		FLOOR/HUE		
		BROWN	GREEN	BLUE
FURNITURE	Y.R.	26	13	3
	NEUTRAL	1	6	13
	B.G.	0	6	4

Table 5.15 - Hue Preferred When Floor Is Compared With Wall And Furniture

FLOOR / WALL		FLOOR/VALUE	
		4 & 5	3 & BELOW
WALL/VALUE	8 & 9	34	17
	7	9	7

FLOOR / FURNITURE		FLOOR/VALUE	
		4 & 5	3 & BELOW
FURNITURE (FEMALE)	7 &	10	12
	6 & 5	6	2
	4 & 3	4	4

FLOOR / FURNITURE		FLOOR/VALUE	
		4 & 5	3 & BELOW
FURNITURE (MALE)	7 &	2	8
	5 & 6	3	1
	4 & 3	8	12

Table 5.16 - Value Preferred When Floor Value Is Compared With Wall And Furniture

HUE				
WALL / FURNITURE		WALL/HUE		
		R.-Y.	WHITE	G.& 13
FURNITURE	Y.R.	31	4	4
	NEUTRAL	9	6	5
	B & G.	5	6	3

Table 5.17 - Hue Preferred When Wall Hue Is Compared To Furniture

HUE			
WALL / FURNITURE		WALL/VALUE	
		8 & 9	7
FURNITURE (Female)	7 &	10	5
	6 & 5	4	8
	6 & 3	6	1

WALL / FURNITURE		WALL/VALUE	
		8 & 9	7
FURNITURE (Male)	7 &	6	2
	6 & 5	4	1
	4 & 3	13	2

Table 5.18 - Value Preferred When Wall Value Is Compared With Furniture Value

5.3.3 Discussion

A comparison of the colour preferences between male and female was made by using X^2 method of comparison. No significant differences at .05 and higher levels were observed with the exception of the preferred value for furniture. However, some differences can be detected at lower levels of significance. Therefore, further studies are needed in order to further validate and establish any differences that may exist for the preferred colours of an office related to the sex and/or age of its users.

The physical stimuli used in this study were various interiors of actual clerical offices of the conventional type. Thus, the elicited similar responses might be attributed to the existance and identification of the preferred colour scheme for conventional office interiors for clerical function in general.

In spite of variations in physical stimuli, similar colour preferences were observed. However, this study was performed during a winter seanson in Edinburgh-Scotland. Further studies are needed to examine the relevance of seasonal and cultural differences in order to verify the validity of the results of this survey.

Following are the results of the analysis:

5.3.3.1 Ceiling:

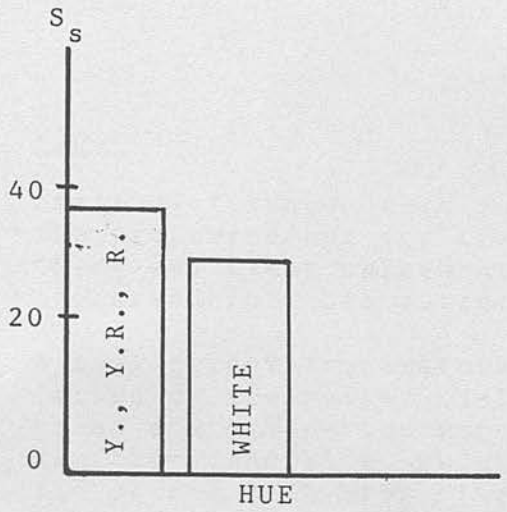
Two hues vied for consideration as the preferred colour for the ceiling. Yellow, yellow-red or red of value eight and nine was preferred as the first, and white as the second choice by the female participants.

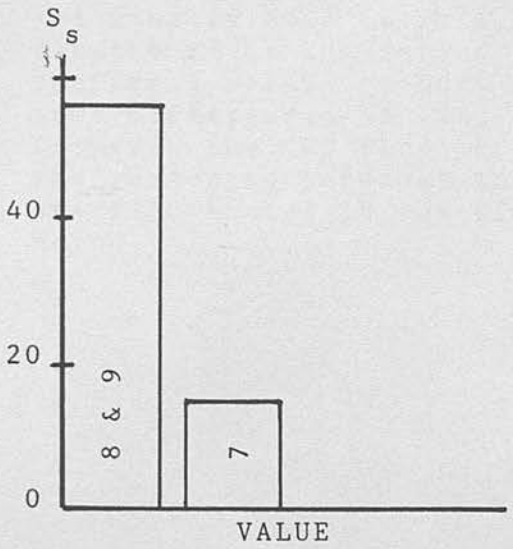
Male choice of preferred hue was the opposite of female. The light yellow, red-yellow, or red was second, while white was chosen as the first.

However, since the significant level of difference was below .05, the responses were put together for the final analysis. This analysis indicates yellow, yellow-red, or red of value 8 & 9 was the preferred

colour for the ceiling, and white, the second choice. It seems that a warm colour temperature was preferred for the ceiling.

The following histogram presents these results.





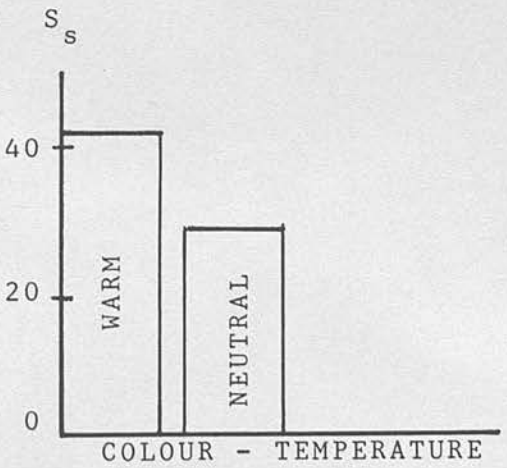


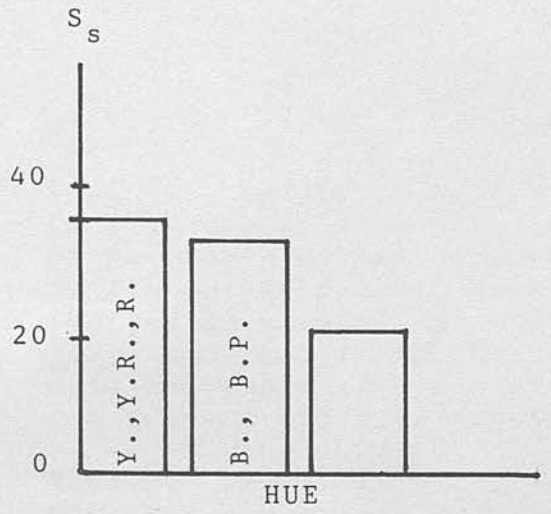
Table 5.19 - Histogram Illustrating The 1st and 2nd Choice of Colours Preferred For Ceiling

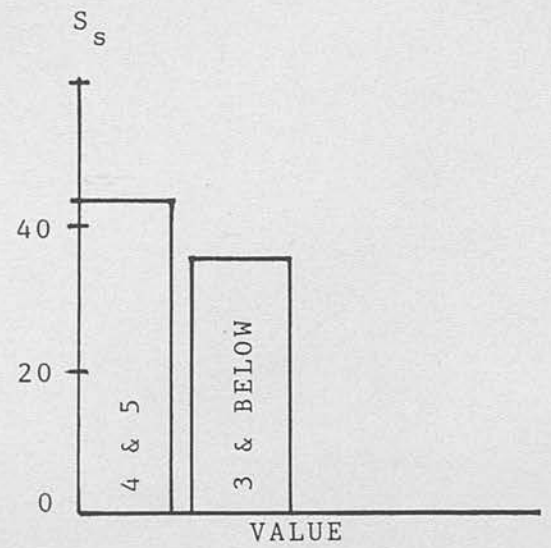
5.3.3.2 Floor:

Small differences were found between the preferred hue for the floor, but there was clear agreement on the value preferred for this surface.

A cool colour temperature was preferred by the males. Yellow-green, green and green-blue were selected as first, and blue, purple-blue as the second with brown (yellow, yellow-red and red) as the third choice.

The females' choice of colour in order of preference were: Brown (Y.,Y.R.,R.), green (Y.G.,G.,B.G.) and finally blue (B.,P.B.). X^2 made for the first and second choices of preferred colour of both sexes showed some differences at .20, but since it is below the .05 level of significance, the responses were put together and are illustrated in the histogram below.





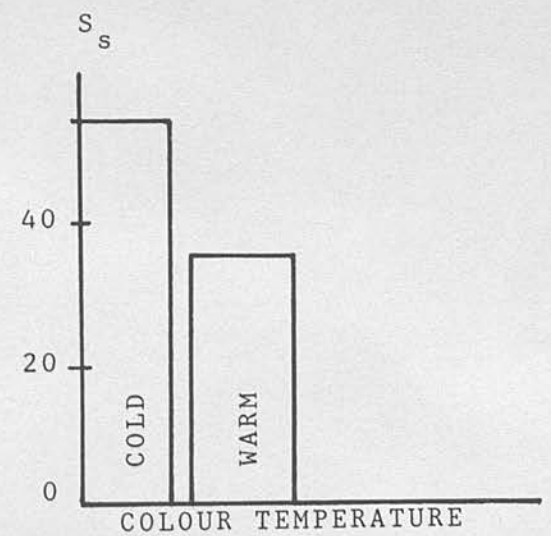
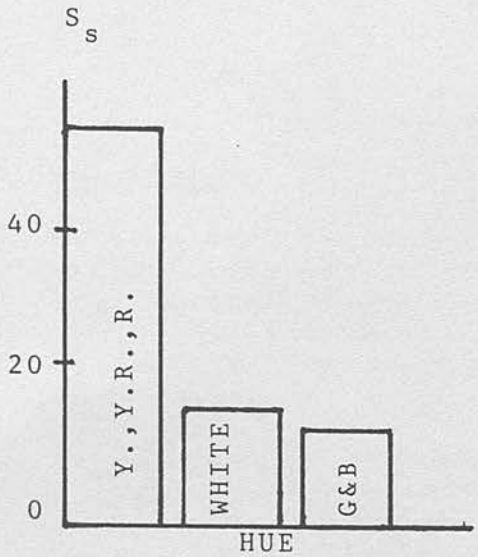


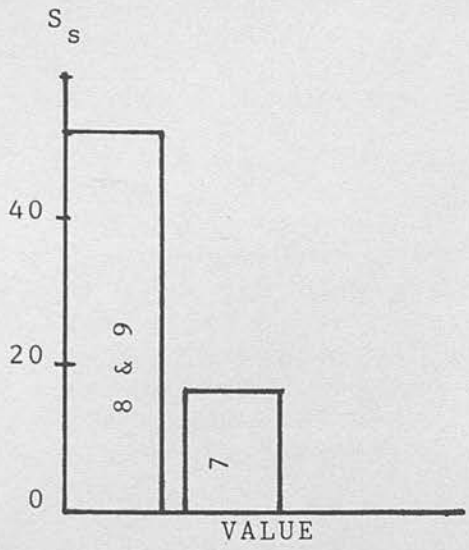
Table 5.20 - Histogram Illustrating The 1st, and 2nd and 3rd Choice of Colour Preferred For Floor

5.3.3.3 Walls:

A similar hue (Y.,Y.R.,R.) and value (8 & 9) was selected as first choice of preferred colour by both male and female participants. However, for females green/blue and white were the second and third choices, while male responses show a preference for the reverse order in these colours.

However, since the significance observed was below .05, the data was considered together for final analysis and is illustrated in the histogram below.





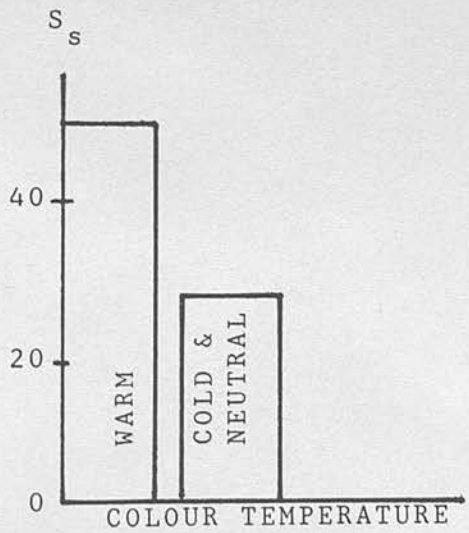


Table 5.21 - Histogram Illustrating The 1st, 2nd And 3rd Choice Of Colour Preferred For Wall.

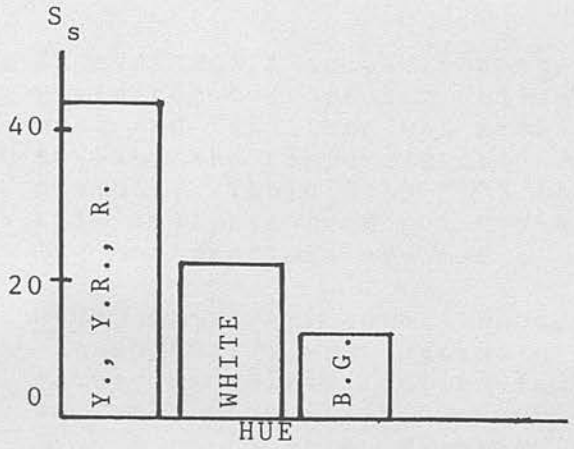
5.3.3.4 Furniture:

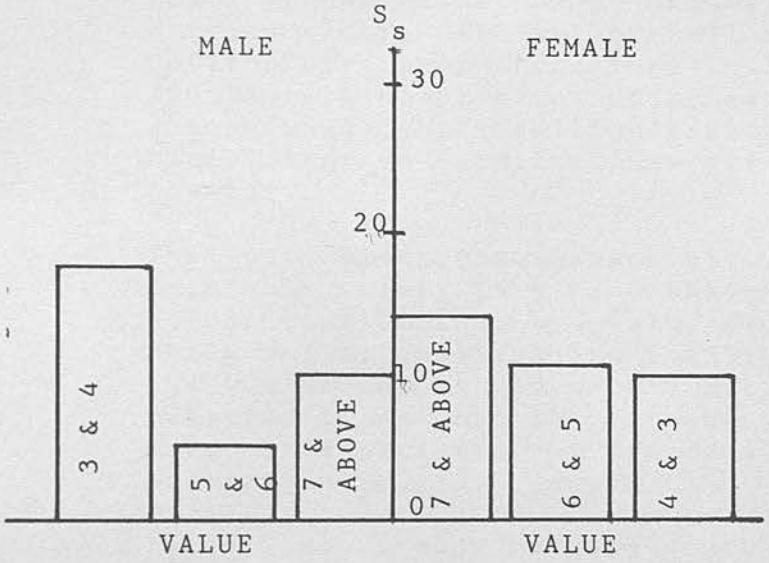
Natural wood was considered by the participants as the best material and thus various shades of brown (Y., Y.R., R.) were the first choice of hue, and white and some neutrals were second.

It was noticed that this second choice was made when the participants expressed a desire for a more modern style of interior arrangement.

The last choice of hue was the category of blue and green. These again, were chosen when a more modern style was preferred over the traditional look.

Although a complete agreement between male and female was observed for the choice of hue, a significant level of difference (.05) was observed for the preferred value. Male participants favoured a low value of 4 & 3. Whereas the female participants preferred value 6 and above. Therefore, only the responses for hue and colour temperature were put together for the final analysis. The histogram below illustrates this result.





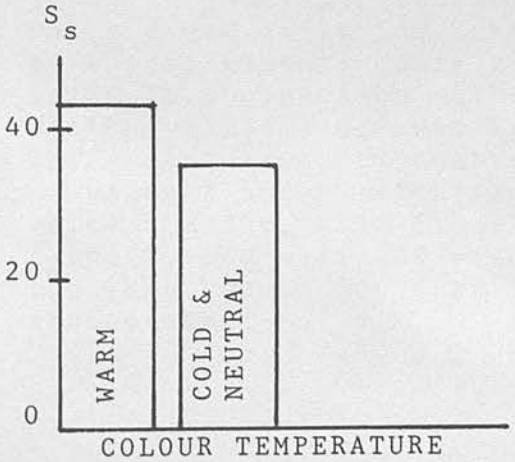


Table 5.22 - 1st, 2nd and 3rd Choice of Colour Preferred For Furniture

In addition a comparison of the preferred colours for ceiling, floor, wall and furniture was made in order to find the preferred colour combinations. Table 5.13 to 5.18 presents this analysis from which the following observations are made:

Hue: Observations of the above tables showed that a combination of various values of yellow, yellow-red, and red were selected as the favourite colours, (e.g. a combination of brown floor, light yellowish wall and celing with brown furniture).

The next preferred colour combination was a green/yellow colour scheme, (e.g. a green floor, with yellow wall and ceiling with brown furniture). In addition, a combination of green floor, yellow wall, white ceiling and white, blue, or green furniture was also popular.

The last colour combination elicited from this survey is a blue/white colour combination, (e.g. blue floor, white walls, ceilings and furniture). The latter colour scheme was often referred to as contemporary and was more often preferred by the female participants.

Value: Two groups of value combinations were generally preferred. The first category contains a combination of value 8 & 9 for ceiling, value 8 & 9 for walls and value 4 & 5 for floor. Female participants desired value 7 and above for furniture and male participants chose value 4 & below in conjunction with the rest of the values mentioned for the room. The second category combines a ceiling of value 8 and 9, with floor of value 8 and 9, with floor of value 2 and 3, and walls of value 7, with the same values for furniture mentioned above.

A summary of the result is set forth in Table 5.19, and in addition, the suggested colour chart elicited from this survey is shown as APP. III-F.

It is quite obvious that a traditional colour scheme is still desired in the office environment. These colour schemes were shown to another group of office workers in order to re-examine their popularity. Fourteen office workers (nine males and five females) who had not participated in the previous study were asked to rank these colour schemes as they would prefer to have them in their own working environment.

Four out of five female subjects selected brown/yellow, green/yellow and blue/white as the order of preference. Three of the male participants also chose the above order of preference, and six others chose green/yellow, brown/yellow, and finally, blue/white. This stage of study was not performed through a formal questionnaire and the age group varied from 24 to 62 years old. Thus no scientific validity is claimed by the investigator.

SUMMARY				
CEILING	HUE →	1 R.,Y.R.,Y.	2 WHITE	
	VALUE →	8 & 9	7	
FLOOR	HUE →	Y.,Y.R.,R.	G	B
	VALUE →	4 & 5	3 & 2	
WALL	HUE →	R.,Y.,Y.R.	WHITE	G. & B.
	VALUE →	8 & 9	7	
FURNITURE FEMALE	HUE →	Y - to R	WHITE	B. G.
	VALUE →	7 & ABOVE	6 & 5	
FURNITURE MALE	HUE →	Y. to R.	WHITE	B. & G.
	VALUE →	3 & 4	7 & ABOVE	

Table 5.23 - Summary Of the Preferred Hue and Value Elicited From This Survey

5.4. Case Study V - "Colour Preference For Semi-Open Plan Interiors"

5.4.1 Procedure

Seventy-six office workers, 38 male and 38 female all age 20-35, participated in this study. An attempt was made to use only participants of similar age group in order to facilitate a comparison of the preferred colour scheme for conventional and semi-open plan interiors.

Visits were made to contemporary office buildings with open or semi-open plan interiors. Methods of procedure similar to the one reported in the preceeding survey were employed. The physical stimuli used in this experiment were, again, actual office interiors. No measurement of the size of these rooms was made, but the smallest contained a group of six staff and the largest, sixteen clerical workers.

The participants were asked to systematically identify their preferred colours for ceiling, floor, wall, low partition and furniture - (APP. III-A). Tables 3 and 4, (APP. III-D) presents the colour preferences from which the conclusions were drawn by analysis. Similar to the method reported before, analysis were made in three stages. Stage 1 presents the X^2 method of comparison for male and female responses and is reported in APP. III-E; Stage 2 exhibits the tabulation of first, second, and often third choices of colour for the physical surfaces of the room; and finally, the third stage of analysis was employed for identifying the preferred colour combination, (see Table 5.23-5.44).

5.4.2 Analysis

5.4.2.1 Second Stage

A - Ceiling: The following tables present the responses gathered from males and females. Separate analysis was made for the two sex groups.

X^2 was made to compare the male responses to the female. As no significant difference was found, the responses were put together as one group. Table 5.26 presents the total responses of the preferred ceiling colour.

CEILING/HUE			
H	1 R,Y.R.,Y	2 WHITE	3 B. & G.
S_s	23	7	4

CEILING/VALUE				
	HIGH			LOW
V	9	8	7	6 & BELOW
S_s	7	7	15	7

CEILING/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	23	11

Table 5.24 - Colour Preferred By Male Participants

CEILING/HUE			
H	1 Y.R.,Y	2 WHITE	3 RED
S_s	19	9	6

CEILING/VALUE				
	HIGH			LOW
V	9	8	7	6 & BELOW
S_s	18	8	9	4

CEILING/COLOUR TEMPERATURE		
T	WARM	COLD
S_s	26	13

Table 5.25 - Colour Preferred By Female Participants

CEILING/HUE		
H	1 Y.R.,Y.	2 WHITE
S_s	42	16

CEILING/VALUE		
V	HIGH 7 & ABOVE	LOW 6 & BELOW
S_s	64	11

CEILING/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	51	24

Table 5.26 - Total Responses To The Colour Preferred For Ceiling.

B - Floor:

An analysis similar to that for ceiling colour preference was made. X^2 did not show any significant differences between male and female and, thus, the responses were put together and are presented in Table 5.29.

FLOOR/HUE		
Hue	1 BROWN (R.,Y.R.,Y.)	2 GREEN
S_s	23	13

FLOOR/VALUE				
VALUE	HIGH 6 & ABOVE	3	LOW 4	5
S_s	6	22	2	4

FLOOR/COLOUR TEMPERATURE		
TEMP	WARM	COLD & NEUTRAL
S_s	23	14

Table 5.27 - Colour Preferred For Floor By Male Participants

FLOOR/HUE		
H	1 BROWN (R.,Y.R.,Y.)	2 GREEN (G.,Y.G.)
S_s	21	10

FLOOR/HUE				
V	HIGH		LOW	
	6 & ABOVE	3	4	5
S_s	3	21	7	3

FLOOR/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	21	18

Table 5.28 - 1st And 2nd Choice Of Colour Preferred By Female Participants

FLOOR/HUE		
HUE	1 BROWN	2
S_s	44	23

FLOOR/VALUE		
V	1 5 & BELOW	2 6 & ABOVE
S_s	62	8

FLOOR/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	44	32

Table 5.29 - Responses For The Colour Preferred For Ceiling

C - Walls:

No significant difference was found when male responses were compared with female. Thus a tabulation was made to present the total responses. Table 5.30 and 5.31 show the separate responses gathered from male and female, and Table 5.3.2 presents the total responses to the preferred colour of walls.

WALL/HUE		
H	1 R.-Y.R.	2 Y.-Y.G.
S_s	23	11

WALL/VALUE				
V	HIGH 5 & ABOVE	LOW 5	4	3
S_s	13	13	9	2

WALL/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	25	12

Table 5.30 - Colour Preferred By Male Participants

WALL/HUE		
H	1 R.-Y.R.	2 Y.-Y.G.
S_s	26	9

WALL/VALUE				
V	HIGH 6 & ABOVE	LOW 5	4	3
S_s	13	14	9	3

WALL/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	23	16

Table 5.31 - Colour Preferred For Wall By Female Participants

WALL/HUE		
H	1 R.Y.R.	2 Y.-Y.G.
S_s	49	20

WALL/VALUE				
			LOW	
V.	6 & ABOVE	5	4	3
S_s	26	27	18	5

WALL/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	48	28

TABLE 5.32 - Total Responses To The Preferred Colour For Wall

D - Low Partition:

Similar analysis was done. No difference were found between male and female and, therefore, the responses were put together and are shown in the following tables.

LOW PARTITION/HUE		
H	1 R.Y.R.	2 Y.G.G.B.
S_s	23	10

LOW PARTITION/VALUE				
V	6	7	9 & 8	5 & BELOW
S_s	3	17	10	7

LOW PARTITION/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	27	10

Table 5.33 - Colour Preferred For Low Partition By Male Participants

LOW PARTITION/HUE		
H	1 R.,Y.R.	2 Y.Y.G.
S_s	26	11

LOW PARTITION/VALUE				
V	6	7	9 & 8	5 & BELOW
S_s	9	21	4	5

LOW PARTITION/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	33	6

Table 5.34 - Colour Preferred For Low Partition By Female Participants

LOW PARTITION/HUE		
H	1 R.,Y.R.	2 Y.G.,G.
S_s	49	21

LOW PARTITION/VALUE		
V	HIGH 6 & ABOVE	LOW 5 & BELOW
S_s	64	12

LOW PARTITION/COLOUR TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	60	16

Table 5.35 - Total Responses To Preferred Colour For Low Partition

E - Furniture:

X^2 analysis does not show any significant difference between male and female for preferred hue, but a significant difference was detected (at .20 level) for the preferred value. However, since the significance observed was below .05, this was ignored and the data was put together for the final analysis.

FURNITURE/HUE		
H	1 R.,Y.R.,Y. BROWN	2 GREY
S_s	30	11

FURNITURE/VALUE			
V	HIGH 7& ABOVE	MED. 6 & 5	LOW 4 & BELOW
S_s	9	11	11

FURNITURE/COLOUR TEMPERATURE		
T	1 WARM	2 COLD & NEUTRAL
S_s	30	17

Table 5.36 - Responses From Male Participants

FURNITURE/HUE		
H	1 Y.,Y.R.,R.	2 GREY
S_s	27	7

FURNITURE/VALUE			
VALUE	7 & ABOVE	6 & 5	4 & BELOW
S_s	6	23	11

COLOUR TEMPERATURE		
VALUE	WARM	COLD & NEUTRAL
S_s	27	12

Table 5.37 - Responses From Female Participants

FURNITURE/HUE		
H	BROWN	GREY
S_s	57	19

FURNITURE/VALUE		
V	MEDIUM 6 & 5	LOW 4 & BELOW
S_s	34	22

FURNITURE/TEMPERATURE		
T	WARM	COLD & NEUTRAL
S_s	57	29

Table 5.38 - Total Responses For Colour Preferred For Furniture

5.4.2.2 3rd Stage of Analysis

The 3rd stage of analysis involved the comparison of the first, second and third choices of preferred colours for ceiling, floor, wall, low partition and furniture and are presented in the following tables.

CEILING / FLOOR		CEILING/HUE	
		Y. TO R.	WHITE
FLOOR HUE	YR.R.	33	7
	Y.G.G.	15	8

C/WALL		Y. TO R.	WHITE
WALL HUE	R.Y.R.	38	7
	Y.Y. G.G.	12	8

C/LOW PART.		Y. TO R.	WHITE
LOW PART HUE	Y.R. Y.R.	38	12
	Y.G.,G.	9	3

C/FURNITURE		Y. TO R.	WHITE
FURNITURE HUE	R.Y.R.	44	11
	GREY	5	2

Table 5.39 - Hue Preferred When Compared With Floor, Wall, Low Partition and Furniture

CEILING / FLOOR		CEILING/VALUE			
		9	8	7	6 & BELOW
FLOOR/VALUE	5	3	1	1	6
	4	2	1	4	
	3	9	12	23	
	6 & >	4			2

C/WALL		9	8	7	6 & <
WALL/VALUE	6 & >	9	5	11	3
	5 & 4	6	10	20	7
	3 & 2	5			

C/LOW PART.		9	8	7	6 & <
LOW PARTITION VALUE	8 & 9	2	9	10	7
	6 & 7	13	7	21	
	5 & <	7			1

C/FURNITURE		7 & >	6 & <
FURNITURE/VALUE	7 & 8	11	6
	6 & 5	33	5
	4 & >	19	2

Table 5.40 - Value Preferred When Ceiling Value Compared With Floor, Wall, Low Partition and Furniture

FLOOR WALL		FLOOR/HUE	
		BROWN Y. To R.	GREEN G., Y.G.
Wall/ Hue	R.Y.R	34	7
	Y.Y.G	4	16

FLOOR/ LOW PARTITION		FLOOR/HUE	
		Y. To R.	G. Y. G.
Low Part/ Hue	R., Y.R.	32	11
	Y.G., G.	6	13

FLOOR/ FURNITURE		FLOOR/HUE	
		Y. To R.	G., Y.G.
Furn./ Hue	Y to R	34	18
	Grey	5	4

Table 5.41 - Hue Preferred When Floor Hue Compared With Wall, Low Partition and Furniture

FLOOR WALL		FLOOR/VALUE			
		3	4	5	7 & ABOVE
Wall/Value	5 & 4	30	6	2	2
	2 & 3	3	0	1	0
	7 &				

F/LOW PART.		3	4	5	6 & ABOVE
Low Part./ Value	8 & 9	13	4	2	1
	6 & 7	26	6	6	4
	5 & Below	2	3		

F/FURNITURE		3	4	5	7 & ABOVE
Furniture Value	7 & 8	5	3	2	5
	6 & 5	24	8		5
	4 & BELOW	4 +	2		2

Table 5.42 - Value Preferred When Floor Value Compared With Wall, Low Partition and Furniture

WALL		WALL/HUE	
LOW PART.		R.,Y.R.	Y. - G.
LOW PART./ HUE	Y TO R	31	10
	YG.G.	7	9

W/FURN.		Y.R. TO R.	Y. - G.
FURN./ HUE	Y TO R	40	16
	GREY	5	5

Table 5.43 - Hue Preferred When Wall Hue Compared With Low Partition and Furniture

LOW PART. FURNTIURE		LOW PART./VALUE	
		8 & 9	6 & 7
FURN./ VALUE	7 & 8	4	9
	6 & 5	13	24
	4 & >	16	(7 + 8 VA)

LOW PART. FURNITURE		LOW PART./HUE	
		Y. TO Y.R.R.	Y.G., G.G.B.
FURN./ HUE	Y TO R	46	7
	GREY	4	

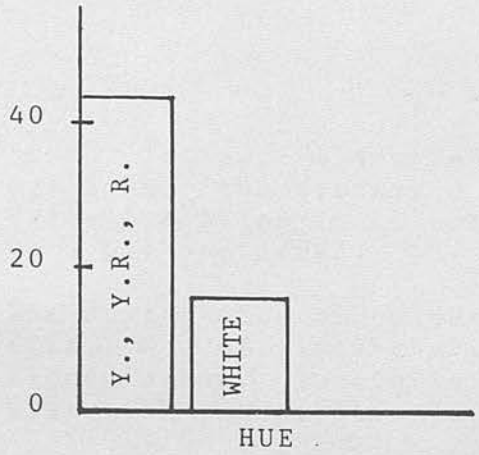
Table 5.44 - Hue And Value Preferred When Low Partition Hue and Value Compared With Furniture

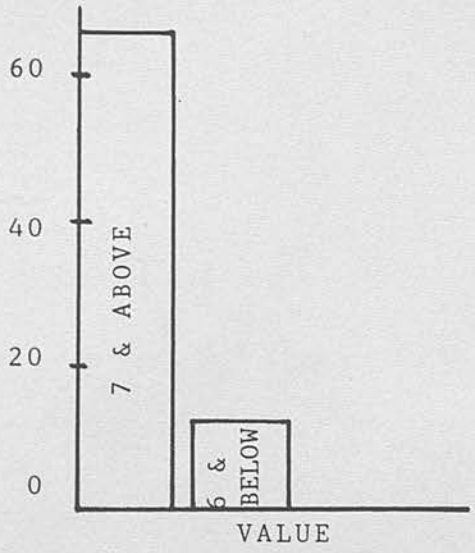
5.4.3 Discussion

Comparison of the colour preferences was made by the X^2 method of comparison. No significant difference was observed between male and female responses and thus the responses were put together for further analysis which involved the identification of first, second and in some cases, the third choice of value, hue, and colour temperature, Tables 5.20 to 5.34 present the analysis from which the following discussion is made. It is interesting to point out that again, in spite of the variation in the physical size and form of the spaces visited, similar responses to colour preference were expressed. Also be reminded that this survey was made during winter and such preference for a warm colour scheme might have been influenced by the cold temperature at the time.

5.4.3.1 - Ceiling:

Yellow, Yellow-Red & Red of value 7 & 1 above (particularly '7') were the colour preferred for ceiling by the majority, with white being the choice of the minority. Hence, a strong, warm colour temperature was preferred over neutral and cold colour temperatures. The following histogram illustrates the first and the second choice of preferred colours.





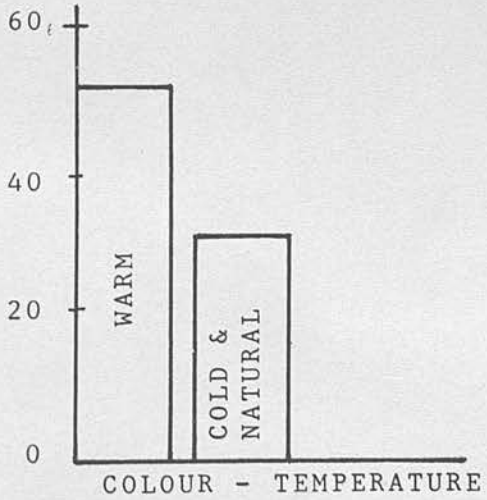


Table 5.45 - Histogram Illustrting The First And Second Choice Of Colours Preferred For Ceiling.

5.4.3.2 - Floor:

Brown (Yellow, Yellow-Red, & Red) was by far the preferred colour. Value 5 & Below (particularly value '3') was preferred.

The next choice of colour was green (G.Y., G.) of similar value mentioned above. The following histogram illustrates this result.

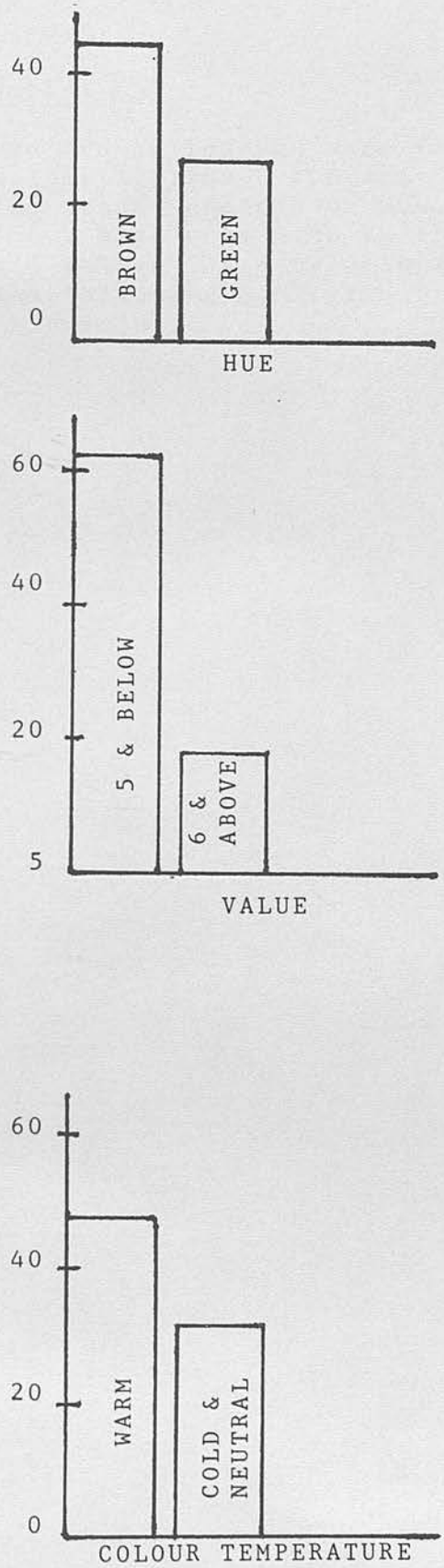
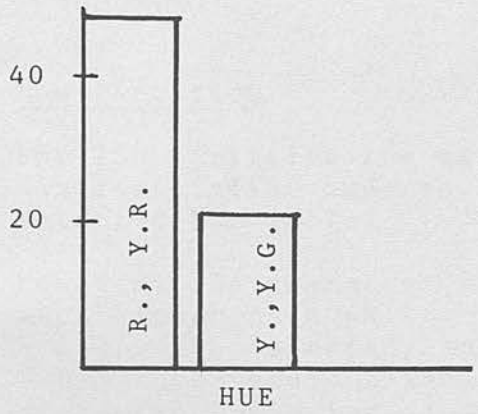
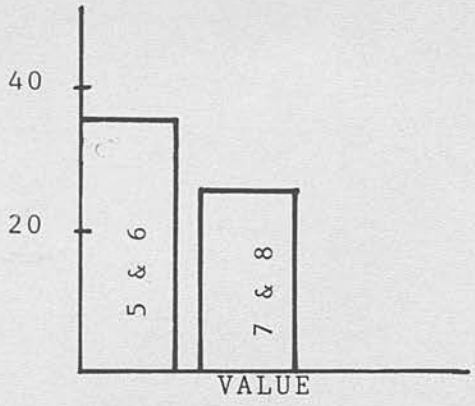


Table 5.46 - Histogram Illustrating The First and Second Choice Of Colours Preferred For Floor

5.4.3.3 - Walls:

Red and Yellow-Red were first and Yellow, Yellow-Green and Green were the second choices of Hue. Values 6 & 5 also were used by the majority and values 7 & 8 came in second. The following histogram presents this result.





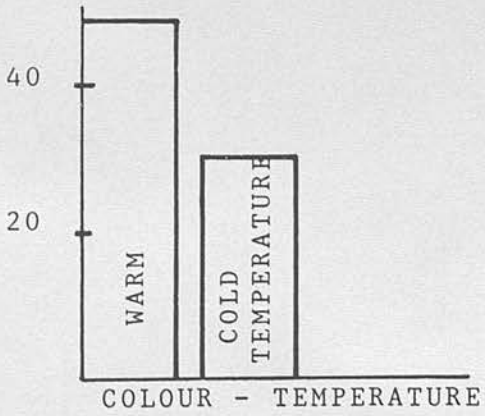
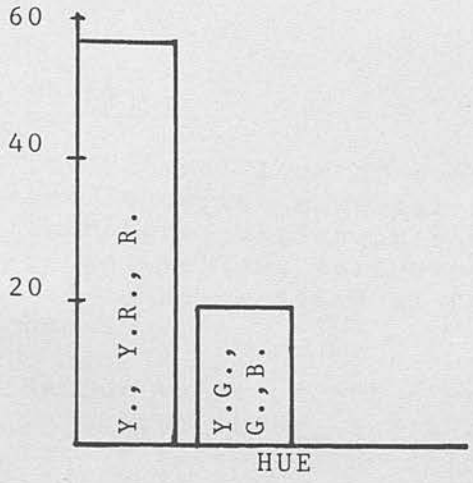


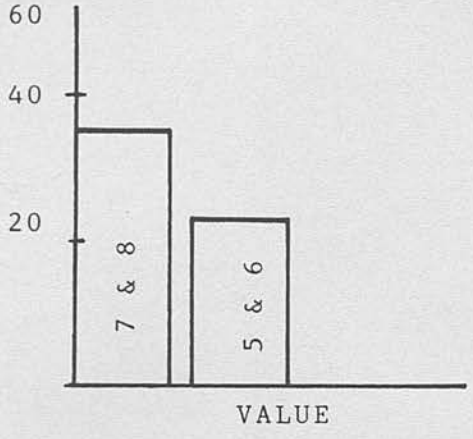
Table 5.45 - Histogram Illustrating the First And Second Choice of Colour For Wall

5.4.3.4 - Low Partition

For low partition the first choice was for similar hues to those selected for walls.

However, the preferred value was much higher than walls. Values 8 & 7 were preferred, and values 6 & 5 were second. The histogram following presents this result.





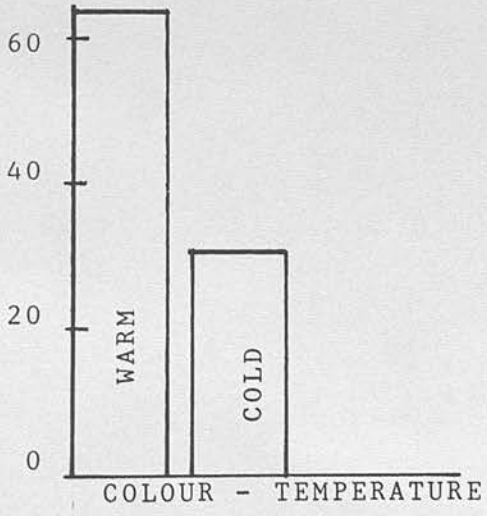
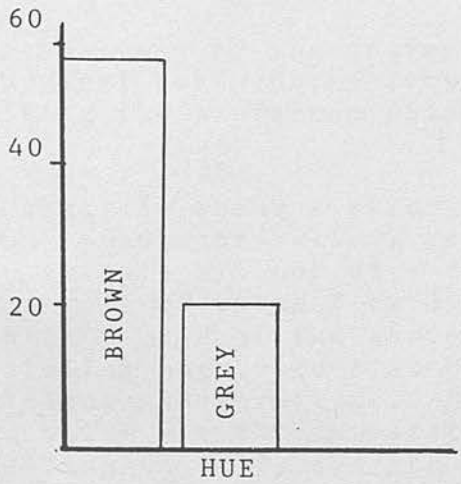


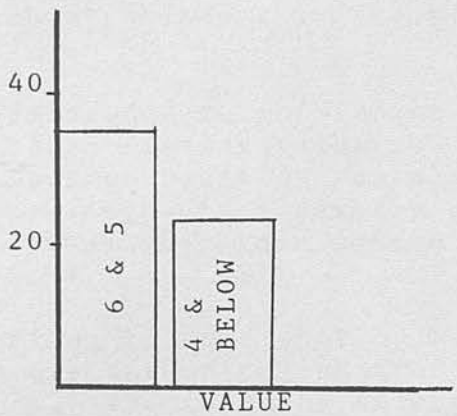
Table 5.46 - Histogram Illustrating The First And Second Choice of Colours Preferred For Low Partition

*Furniture:

The natural look of wood was again the favourite material for desks. Therefore, different shades of brown (yellow, yellow-red, and red) were selected as favourite hues.

Medium value of 5 & 6 was the favourite value, and 4 & 3 became second. The following histogram illustrates this result.





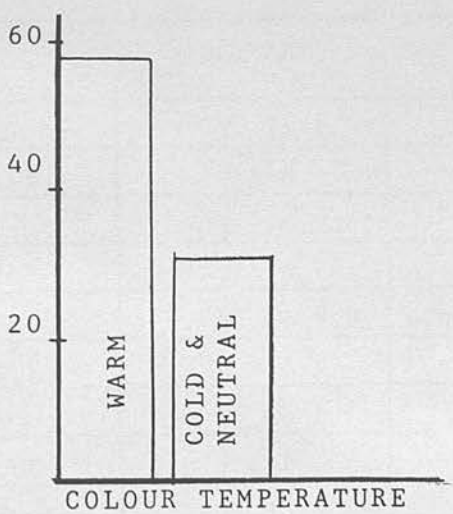


Table 5.47 - Histogram Illustrating The First And Second Choice Of Colours Preferred For Furniture

In addition to the analysis of the preferred colours for each of the physical surfaces, a further analysis was made for eliciting the preferred colour combination:

The previous analysis shows a strong domination of various shades of yellow, yellow-red, and red. For example a floor with a value of 3 or 4, with a wall of value 6 or 5, and a ceiling of value 7 or 8 of the above hues were preferred. Similar hues were also preferred for low partitions and furniture. However, the preferred value for the low-partition was similar to ceiling (7 & 8), and the furniture preference seemed to have been a medium value of 5 & 6. It is interesting to note that in both office interiors the preferred value for furniture acted as an intermediary to tone down the contrast brightness of the physical surfaces which might exist in the visual environment.

The second preference colour scheme seemed to be yellow/green. Similar value to the first choice of colour composition was also referred. The table below presents a summary of the first and second choices of colour scheme desired for office interiors.

It is interesting to note that both colour compositions are the so called traditional colour schemes. The tendency to prefer traditional colour schemes was also found in the previous survey. A suggested pallet based on the analysis is presented as APP-IIIG.

SUMMARY			
CEILING	HUE	Y. To R.	White
	VALUE	7 & 8	9
FLOOR	HUE	Y. To R.	Green Y.G. To G.B.
	VALUE	3 & 4	6 & 5
WALL	HUE	R. To Y.R.	Y. To G.
	VALUE	6 & 5	7 & 8
LOW PART.	HUE	Y. To R.	Y.G. To G.B.
	VALUE	7 & 8	5 & 6
FURNI-TURE	HUE	Y. To R.	Grey
	VALUE	6 & 5	4 & 3

Table 5.48 Summary Of The Preferred Colour For Semi-Open Plan Interior.

5.5 Comparison of the Colour Preference in Semi-open Plan and Conventional Interiors.

5.5.1 - Ceiling:

Similar hues were preferred in both types of offices. However, a lower value was preferred by the majority for the ceiling in the semi-open plan interiors (the height of the ceilings were generally the same). Hence, the different responses to ceiling colour values might be attributted to the volume and size of the interior space. The following table presents the comparison of preferred ceiling colour in these office types. In addition a histogram is drawn to further illustrate the differences observed in the surveys reported here.

Ceiling	SEMI-OPEN PLAN			CONVENTIONAL		
	Hue	Value	Colour Temperature	Hue	Value	Colour Temperature
1st Choice	Y To R	7 & 8	Warm	Y to R	8 & 9	Warm
2nd Choice	White	6 & <	Neutral & Cold	White	8 & 9	Neutral & Cold

Table 5.49 - First and Second Choice of Colour For Ceiling In Above Office Types

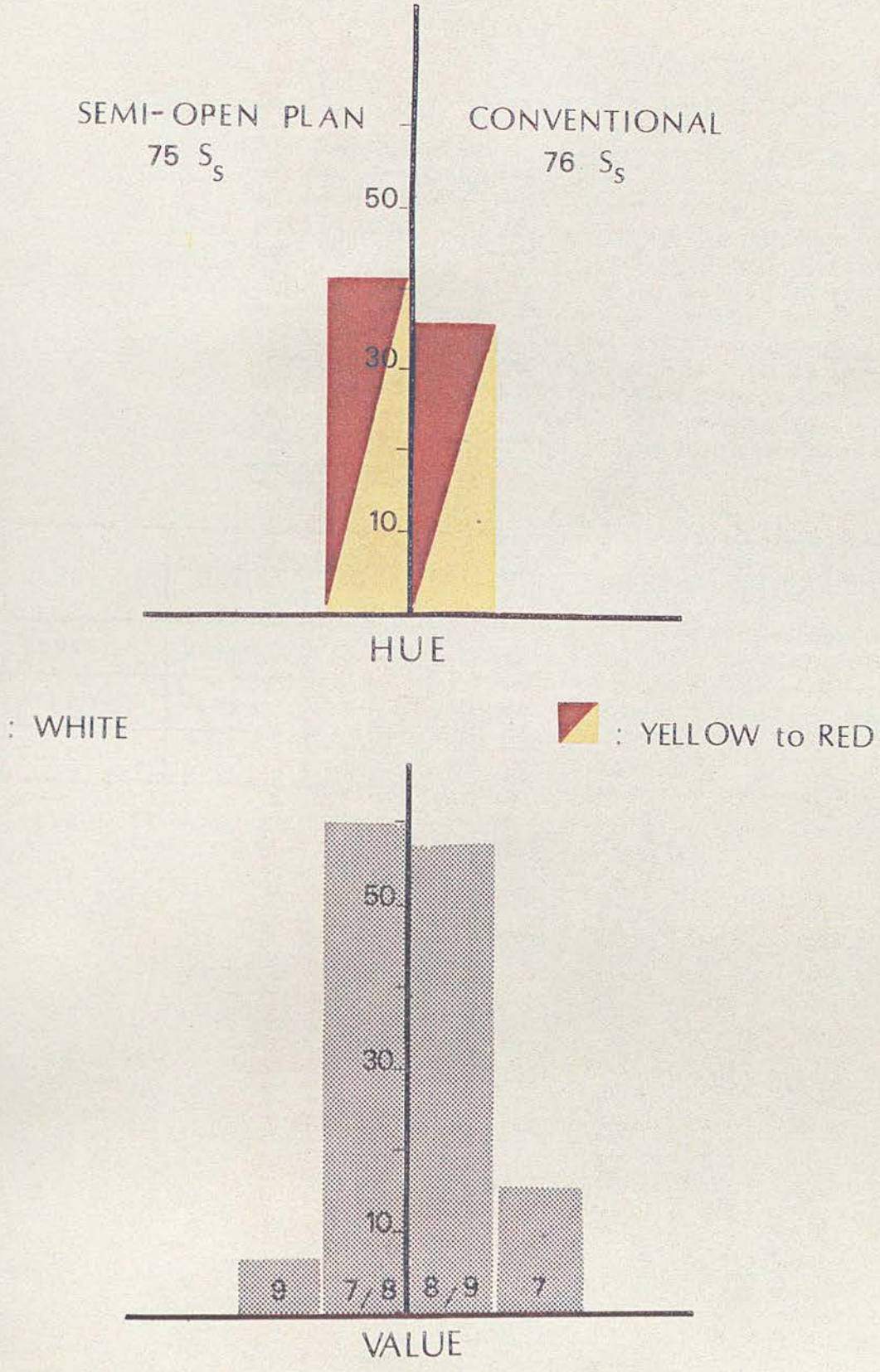


TABLE 5.50 HISTOGRAM ILUSTRATING THE COMPARISON OF THE PREFERRED COLOURS FOR CEILING

5.5.2 Floor

Similar hues were preferred for the floor of the conventional and semi-open plan although the preferred value is somewhat surprising. A higher value is preferred for the floor of the conventional interiors when first choices were compared, whereas a lower value was selected in the conventional interiors. In addition a cool colour temperature was preferred for the floor of conventional interiors and a warm colour temperature for larger office spaces. The following table and histogram illustrate these findings.

Floor	Semi-open			Conventional		
	Hue	Value	Colour Temp.	Hue	Value	Colour Temp.
First	Brown	3 & 4	Warm	Brown	4 & 5	Cold
Second	Green	6 & 5	Cold	Green	3 & 2	Warm
Third				Blues		

Table 5.51 - First, Second and Third Choices Of Preferred Colour For Floor.

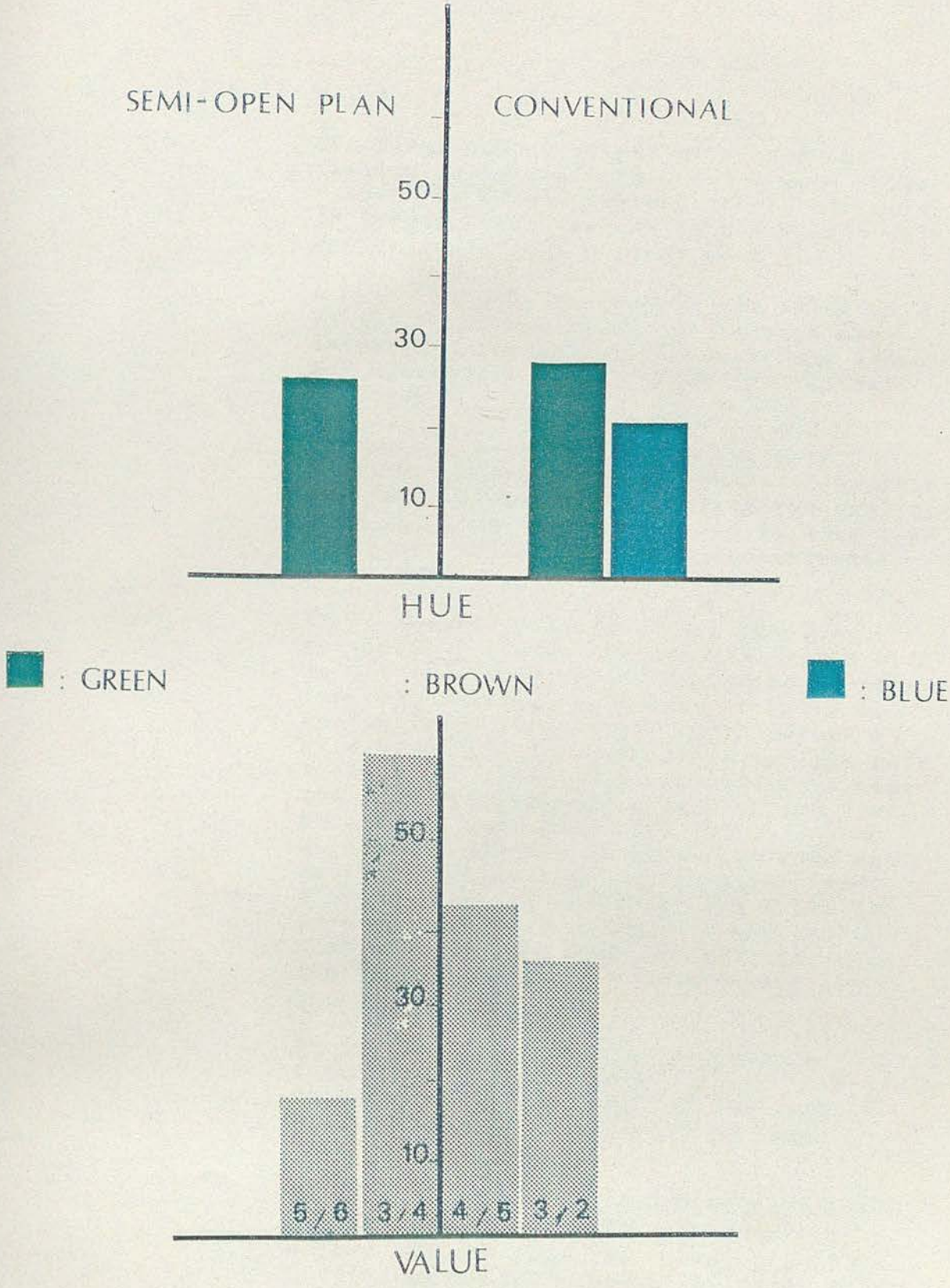


TABLE 5.52 HISTOGRAM ILUSTRATING THE COMPARISON OF THE PREFERRED COLOURS FOR FLOOR

5.5.3 - Walls

The first choice of preferred hue was similar in both offices, but a much lower value (5 & 6) was preferred for the walls in larger sized offices when compared with conventional office rooms (8 & 9).

A light yellow, yellow-red was selected as the first choice of hue in open plan interiors, whereas white became the second and green-blue the third choice in small offices.

The second preferred value was very similar in both offices. Further comparison was made between the low-partition semi-open plan rooms and its walls, and between low-partition and walls in the conventional interiors.

It is important to note that the low-partition provides the personal space within the office organization and hence its function is similar to that of walls in conventional interiors. Light values were preferred for both walls and low partition. An interesting discovery is that the preferred value for ceiling and low-partion in semi-open plan interior and also the preferred value for ceiling and walls in conventional offices were very similar. The low value of the walls in open-plan offices provided a medium contrast compared with the ceiling value and hence provided a more dominant and pronounced background.

It is likely that the respondants attempted (conciously or subconciously) to increase or decrease the visual size of the room by manipulating the brightness of the surrounding surfaces.

In summary, a lighter value was preferred for the rooms with smaller volume and darker surfaces for the larger interiors. The following histogram illustrates these findings.

WALL	Semi-open Plan			Conventional		
	Hue	Value	Color Temp.	Hue	Value	Color Temp.
1st	Y.R. To R.	5 & 6	Warm	Y. To. R.	8 & 9	Warm
2nd	Y. To R.	7 & 8	Cold	White	7	Neutral
3rd				Green & Blue		Cold

Table 5.53 - First, Second and the Third Choice of Preferred Colour For Walls

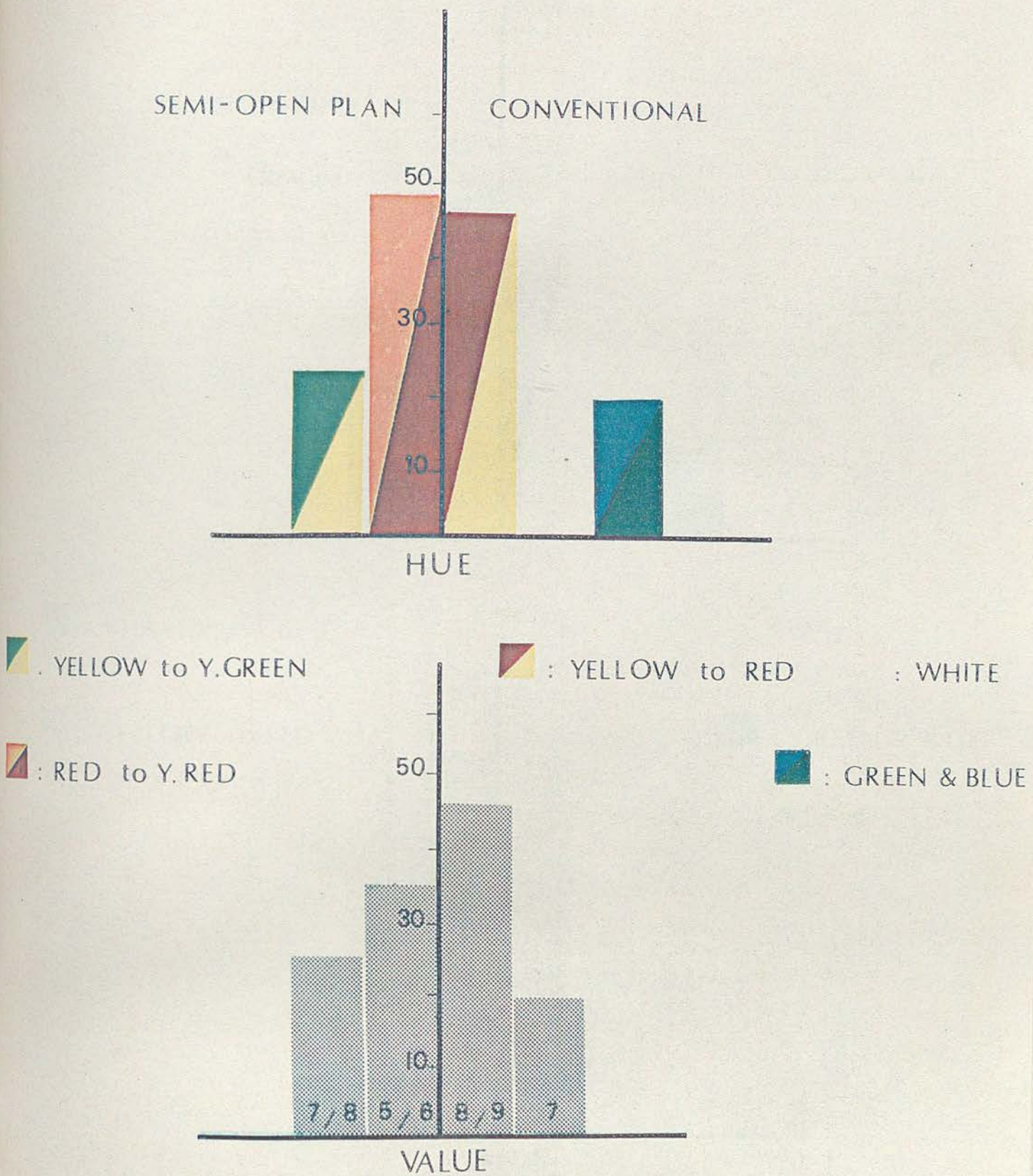


TABLE 5.54 HISTOGRAM ILUSTRATING THE COMPARISON OF THE PREFERRED COLOURS FOR WALL

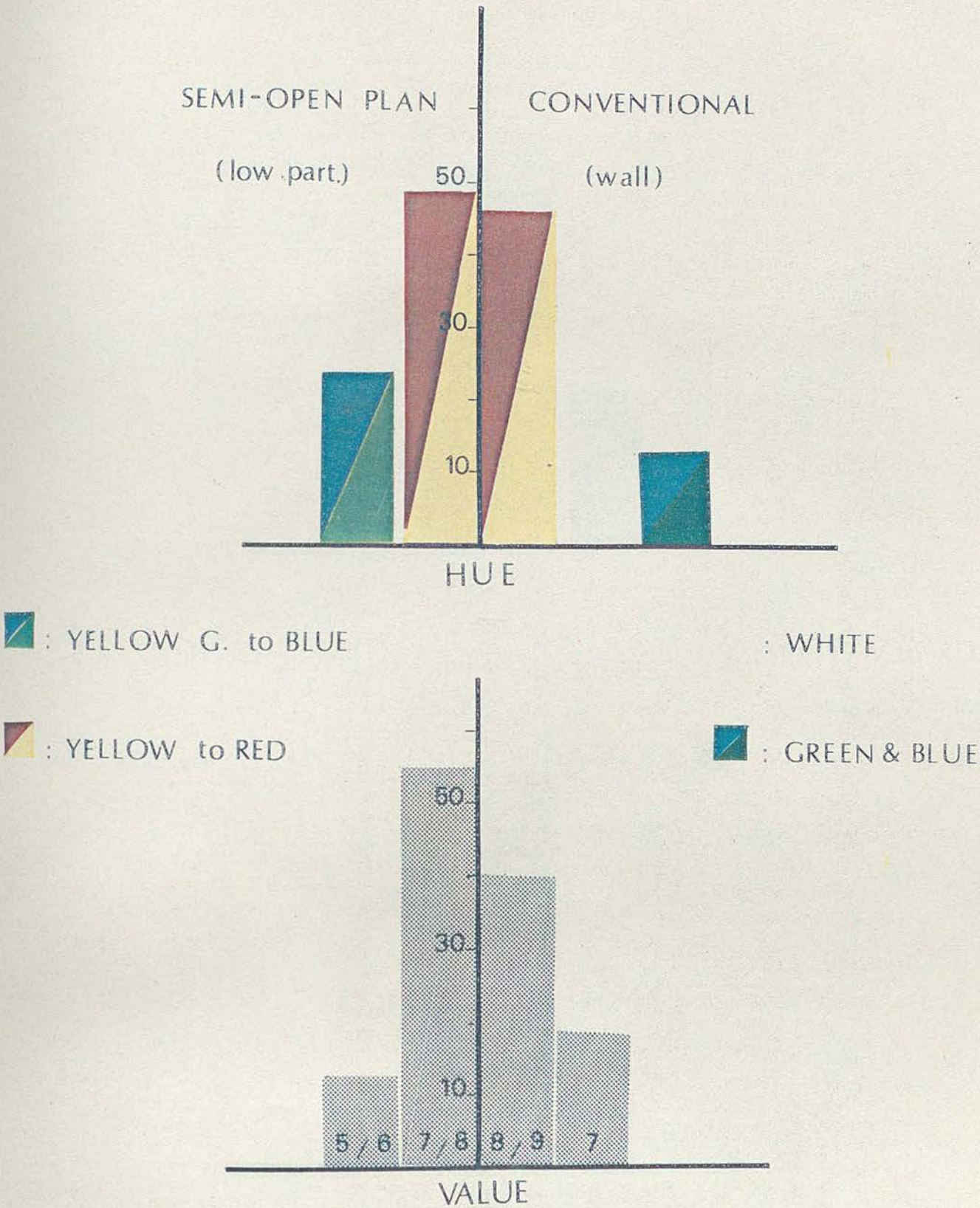


TABLE 5.55 HISTOGRAM ILUSTRATING THE COMPARISON OF THE PREFERRED COLOURS FOR THE LOW PARTITION & WALLS OF THE CONVENTIONAL OFFICES

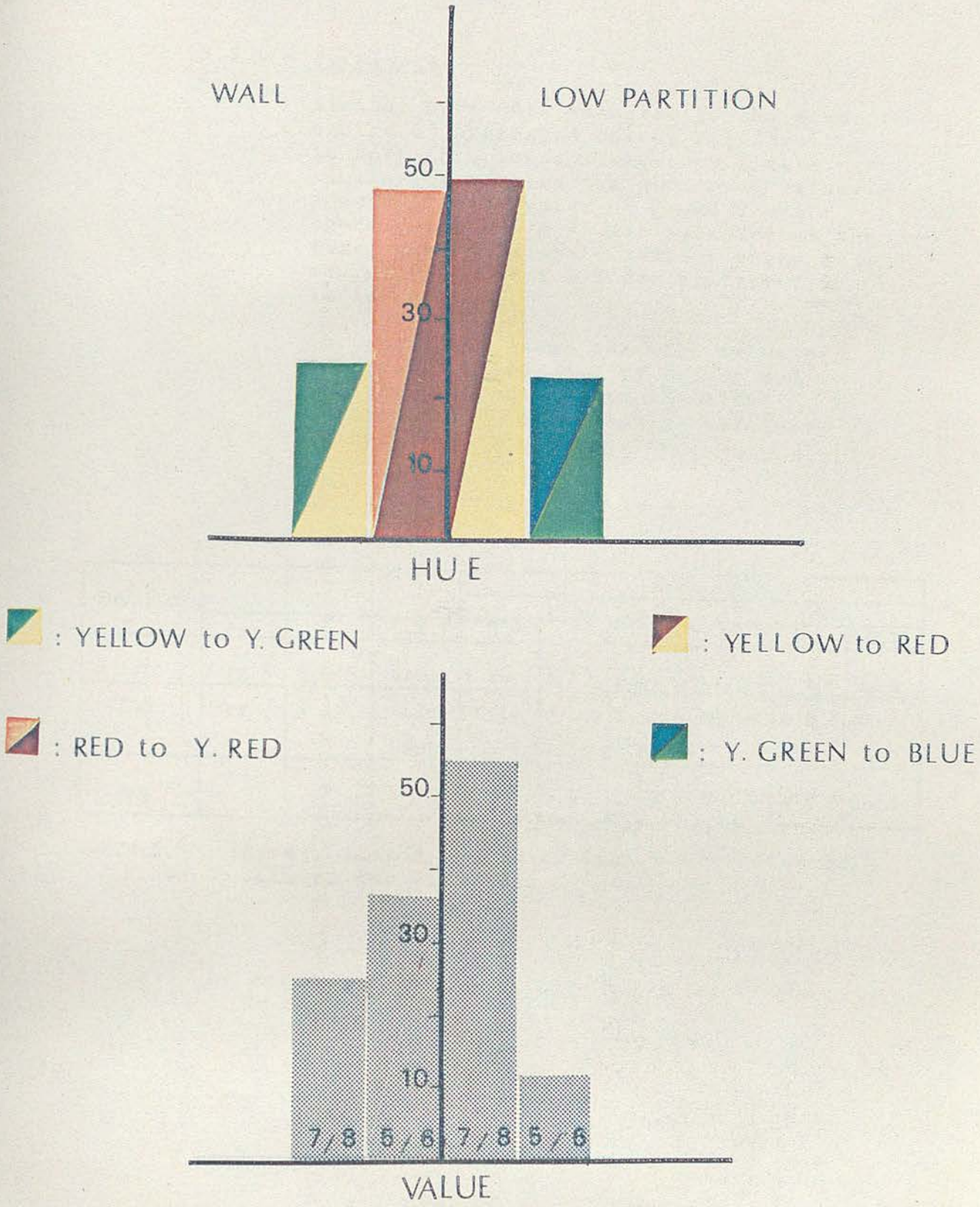


TABLE 5.56 HISTOGRAM ILUSTRATING THE COMPARISON OF THE PREFERRED COLOURS FOR THE LOW-PARTITION & WALLS OF SEMI-OPEN PLAN OFFICES

5.5.4 - Furniture

Similar hues were selected as the first choice of preferred colour for furniture in both interiors. There was little similarity between the preferred values. A much lighter value of 7 and above (particularly 8 & 9) was selected as the first choice in small offices where as a medium value of 6 & 5 was preferred in larger offices.

In general it seems that the value of furniture was selected to reduce and balance the contrast in the visual environment. The following histogram illustrates this comparison.

Furniture				Conventional					
				MALE			FEMALE		
	H.	V.	C.T.	H	V	C.T.	H	V	C.T.
1st	Y to R	6 & 5	Warm	Y to R	7 &>	Warm	Y to R	7 &>	Warm
2nd	Grey	4 &>	Cold & Neut.	White	3 & 4	Neut.	White	6 & 5	Neut.
3rd				B & G	5 & 6	Cold	B & G	4 & 3	Cold

Table 5.57 - First, Second and Third Choice of Preferred Colours for Furniture

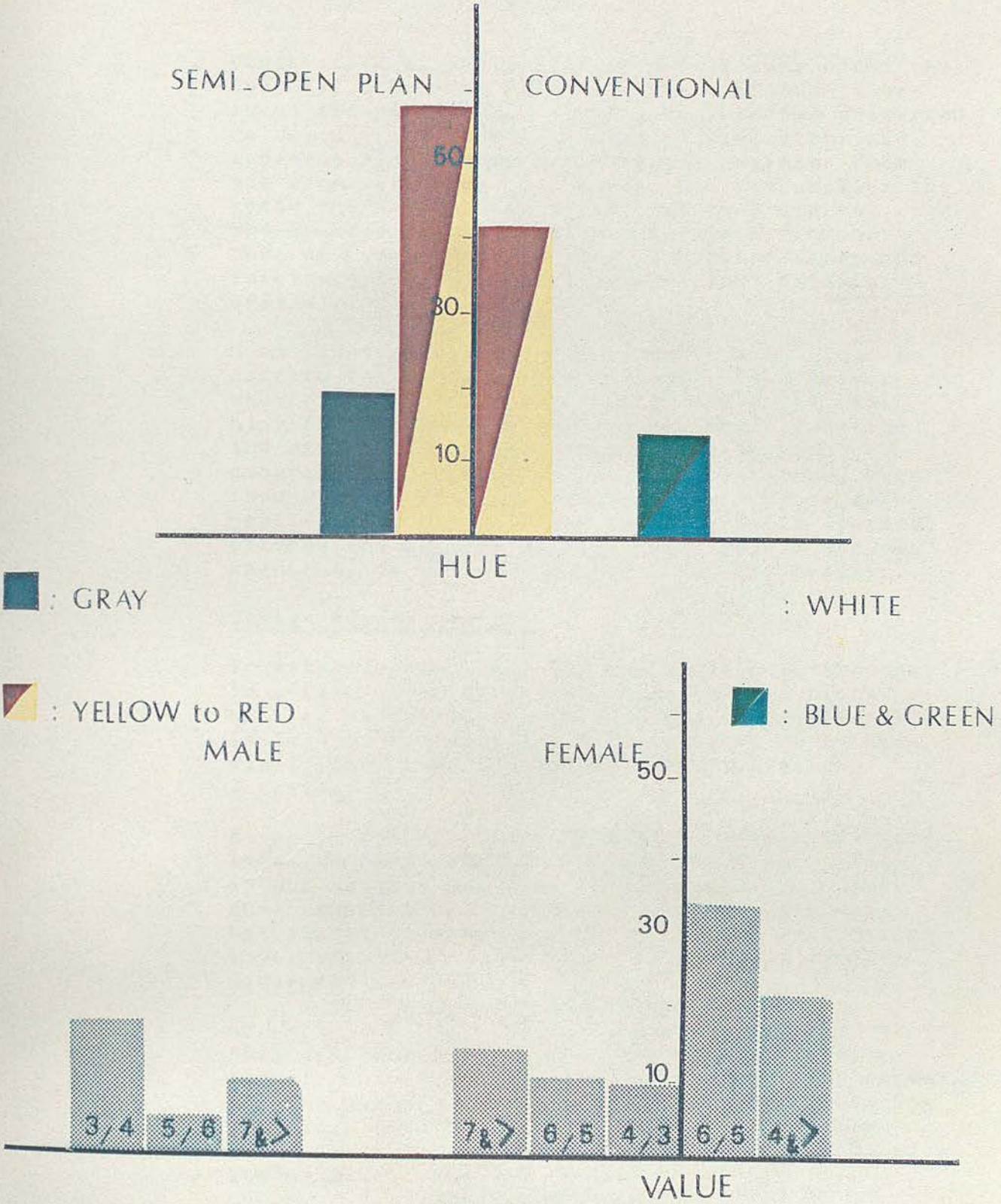


TABLE 5.58 HISTOGRAM ILUSTRATING THE COMPARISON OF THE PREFERRED COLOURS FOR FURNITURE

Observation of the preferred colour scheme for the two office interiors indicates a relationship between the preferred hue and particularly, preferred value, and the size of the space and, also, the apparent distance of the vertical surfaces from the observer. This indicates that the smaller the space the lighter the value that is preferred. The preceeding tables also indicate a tendency towards a cooler colour temperature for floor and furniture in smaller office interiors (single office).

Much research still needs to be done in order to confirm the results reported here. The preference of colour is often complex and based upon many factors among which are the mood, function and size of the space, cultural background geographical condition, ...etc. Therefore, even though a set of colour schemes might prove to be popular with the majority in the general clerical offices the may not be favourable colour schemes when one, or all, of the above factors changes.

5.6 Design Recommendation

To establish an ideal and comfortable environment in offices - on walls, ceilings and floor, as well as on furniture and equipment - brightness (value) of the surfaces is considered to be more significant than hue and must receive more attetion.

However, this has been used as an excuse to overlook the importance of environmental colouring in our working spaces. As a result, the visual environment of many offices is seldom anything but shades of grey in order to ensure an accurate level of brightnesses needed for visual performance and comfort.

As we have witnessed throughout the past few years, this approach has created many boring and undesirable interiors deprived of colour. This survey and the studies reported in Chapter IV illustrate a serious desire for a more chromatic working environment supportive of the emotional needs of its users.

The survey reported here offers some tentative guide lines on preferences of hue and value to be used in office interiors. The first and second choice of colour schemes are both based on natural colour combinations, and are also referred to by the participants as a "traditional colour schemes" popular in Britain. Hence, these combinations may

or may not be acceptable in other cultures. Therefore, the investigator finds it hard to recommend the above colour schemes as the most popular and suitable for office interiors in general. The decision on hue selection must be made after considering factors such as taste and style of the users, their cultural background, geographical and climatic conditions, orientation of the interior, visual durability and many other factors.

The validity of the suggested colour-schemes elicited from these surveys relies on further investigation to re-examine these findings in different seasons, cultures, with different geographical locations and in activities other than clerical.

5.7 General Discussion and Conclusion

A review of the related literature indicates that colour preference has been investigated from two different levels. One, biological, which postulates a biological order of preference related to wavelength and was more concerned with hue than with value or chroma. The other, the more recent theory, has been more concerned with the value, and chroma dimensions. This view postulates that any like or dislike is based not on hue but on the value and chroma.

Hans Eysenck (1941)[2] carried out an investigation into colour preference and he suggested the following order of general preference: Blue, red, green, violet, orange, yellow. He later on combined his result with the similar results of other international studies and called the above scale the 'universal scale' of colour preference. He further suggested that there is some biological basis for preference of short wavelength to long wavelength.

J.P. Guilford[3-4] (1930) in his studies of colour preference also suggested a basic biological cause for basic like or dislike of colour.

Piaget's Theory of the Chronological Stages of Development indicate that a change from liking the long to short wavelength colour seems to occur in a child after the 'egocentric stage' between two to five years, and it might coincide with his third developmental stage, 'incipient co-operation', between the ages of seven and eight.

Tom Porter[5] carried out a series of tests with children between the ages of 5 to 9. His observations indicate a general liking for red up to age 7 and an indication of preference for blue colour by eight or nine years. He further ran several colour preference tests with the 18 to 25 age range with several nationalities and suggested the following colour preferences: blue and green, violet, orange, red and yellow.

It is interesting to note that there is a process of deterioration of the eye with age. A greying affect on the perception of colour is produced through occurance of a form of skin, which makes it difficult to gradually discriminate between green and blue. In reference to this fact Tom Porter[6] tentatively suggests that a reason for such strong preference for blue and green might be "...that they indicate agreement of an established liking for short wavelengths or that the ageing eye is seeking 'peace' in the pasive colours. The blue and green hues possibly being perceived as neutrals".

The more recent theory is put forward by Cari-axel Acking, Richard Küller and Lars Sivik in Sweden[7-8]. Their investigation is more concerned with value (brightness) and chroma (saturation) using semantic differential techniques. They found no significant order of preference, but claim that any liking was based only on value and chroma dimension. Küller has stated that "although some people believe the opposite, there is no direct correspondence between the colour experience and wavelength."

However, in the centre of this controversy a few questions can be raised considering the application of these findings. Can we assume that the preferred colours will be accepted in three dimensional spaces, and if so, can it be suitable for all kinds of functions performed in them? How about the effect of climate and temperature? Does it mean people prefer a unified colour scheme under any geographical condition? Can we assume that colour preference has nothing to do with mood? If so, why have people been using colour for mood creation for centuries!? How about cultural differences?

The colour preference investigations made by the investigator indicated a strong preference for a warm colour scheme for the office interiors. A combination of various shades of red and yellow-red of the Munsell colour atlas were preferred.

Red and orange are known to be energetic, exciting, cheerful, warm ... etc.

Based on observation, the investigator tentatively suggests that many factors might have contributed to the selection of the above colors:

A) The Current Function of the Office

The offices visited were of a clerical nature, i.e. paper work. This does not involve any strong physical activity. Thus, a more exciting and energetic atmosphere might have been desired for their working environment.

B) Climatic Conditions

This study was carried out during the winter season. Therefore, we might be able to attribute such a preference for a warm colour temperature to the cold and gloomy climate at that time.

C) Cultural and Traditional Background

A combination of brown-orange-yellow, and off whites, or dark green-yellow and off white, was preferred by the majority of office employees participating in the survey.

The above colour scheme is often considered to be traditional. British and especially Scotish, are strongly traditional and, therefore, this may have contributed to the selection of the colour they would prefer to work in.

As it was evident from the literature reviewed and the case studies reported in this chapter, that colour preference is a complex subject, and yet the nature and reason behind these preferences are not known. Much more research is needed in this area in order to develop insight and find the solution.

A useful study might be to conduct a series of colour preference surveys for various interiors (offices of various natures; hospitals, resturants ... etc.) in different countries on all three dimensions of colour: hue, value and chroma. To compare the results and identify similarities, which might establish universal facts about colour would be a large, expensive and time consuming operation but, a great deal can be learned through such surveys.

5.8 Summary

This chapter reports a survey of colour preferences in office interiors in Britain. Two case studies were conducted related to conventional and semi-open plan interiors.

Several offices of the above types were visited in Scotland-Britain for the purpose of this study. The subjects participating were male and female office employees age 21-35.

Three groups of colour schemes were preferred as the first, second and third choices. The first and second preferred colour schemes were based on natural colour schemes traditionally popular in Britain. The third choice was not related to natural colour composition and was referred to as contemporary. Discussion was made from the analysis, and the result was compared with other studies related to colour preference. A summary of the result is shown in Tables 5.23 and 5.48 and suggested colour schemes for conventional and open-plan office interiors are proposed and shown as APP. III-F and APP. III-G.

CHAPTER SIX

CHAPTER VI - CASE STUDY VI: "INTERACTION OF FURNITURE DENSITY AND ARRANGEMENT AND COLOUR OF ROOM"

6.5.10 Question 10: A) Does Interaction Of Colour And Funiture Arrangement Affect Communication?

B) Does Colour, Furniture Arrangement And Density Affect The Judgement Of Spaciousness, Friendliness And Pleasantness In A Room?

6.6 Discussion

6.6.1 Communication

6.6.2 Spaciousness

6.6.3 Friendliness

6.6.4 Pleasantness

6.7 Conclusion and Summary

Case Study VI - "Interaction Of Furniture Density And Arrangement And The Colour Of Room"

6.1 Introduction And Aim

It is commonly believed that colour can affect the perception of space through manipulation of hue, value and chroma.[1-2] In addition, the density and size of furniture can make the space look spacious or cramped.[3-4-5] For instance, a large sofa in a small room can cause the space to look smaller due to the interaction of the size (proportion) of the sofa to the room size.

As both of the above physical elements affect the perception of space, some form of relationship (interaction) may also exist between the furniture density and arrangement and the colour of the room. This in return may affect the perception of space and the desired arrangements within it.

The above notion formed the hypothesis, which was tested through the experiment reported below. This experiment was rather like throwing a stone in the dark, as no study has been made here-to-fore to look into the interaction of room colour and furniture.

The purpose of this experiment was two-fold: One, to find the preferred arrangement for office interiors devoted to clerical function, and, second, to determine whether there is any relationship between the preferred furniture arrangement its size and density, and the colour of the room.

6.2 Method Of Approach

It has been argued that a conflict exists between the strict methodology of the psychologist, and the relevance to real problems demanded by the architectural practitioner.[6] The conflict is particularly noticeable in the application of fairly standard psychological techniques to architectural situations of a complexity far greater than the controlled conditions within which these techniques have evolved. Hence, "Gaming" as a research technique in architectural psychology has been put forward to serve as a common interactive paradigm for research and design.[6]

The concept of gaming has been used by a number of behavioural scientists as an analogue of human activity.[7-8] This method is not novel in either sociology or psychology, but it is the method used least often in architectural psychology.

It is impossible to advocate one or two techniques as the only methods of understanding man's interaction with his environment. The appropriateness of the technique has to be decided in relation to the kinds of questions to be asked. However, gaming seems to be a very useful technique in evolving a design process. It provides direct, simple interaction between the users and the space and communication between the users and designer. This results in further understanding of man's complex physical and psychological needs within a particular environment and, eventually, to the design of the space.

Gaming seemed particularly suitable for this experiment as the investigator wanted the user's participation and manipulation of space under different colour conditions.

6.3 Apparatus

A scale model (one-twentieth) of an actual office room 3.5 x 5.5 meters with scale models of office furniture were used in order to simulate a conventional office interior. A medium grey was used for the floor, and the furniture was kept in neutral shades of black to white. The ceiling was presented in white, and the subjects were able to raise or lower the ceiling. Whites, yellow, red and blue were used as a four colour variation to facilitate the study of interaction of colour and furniture. Finally, two scales were fixed to two sides of the floor in order to facilitate the reading of measurements, see Figure 6.1.

6.4 Procedure

The scale model above was viewed by four groups of subjects (11 to 8 S_S in each group, age 23-42). Each group viewed only one colour condition and one subject at a time in their own office environment. An attempt was always made to orient the window of the scale model within a maximum of 1 m. distance from the actual window of the room in order to simulate the natural daylight. Furthermore, visits to these offices were always made between

1 and 2 P.M. on overcast days in order to provide some control of the lighting conditions.*

Subjects were told to imagine the model viewed was his/her work room and urged to arrange it as he/she preferred by using any number of the scale models of furniture available. They were then asked to decide on the desired height of ceiling by using the moveable ceiling provided. (See Questionnaire, App. IV-A).

Photographs and measurements taken of each arrangement served as the basis for analysis (Ref. App. IV-B). Type and number of furniture available to the participants were:

A - Desk (1)

B - Desk Chair (1)

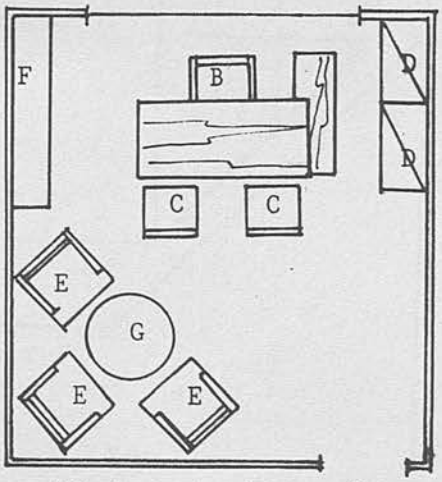
C - Guest Chair (2)

D - Filing Cabinet (4)

E - Lounge Chair (3)

F - Bookcase (2)

G - Lounge Table (2)



After each arrangement by a participant, the other members of the group rated it on a scale from 1 to 5 according to their judgement regarding spaciousness, friendliness and pleasantness. (See App. IV-C for this questionnaire).

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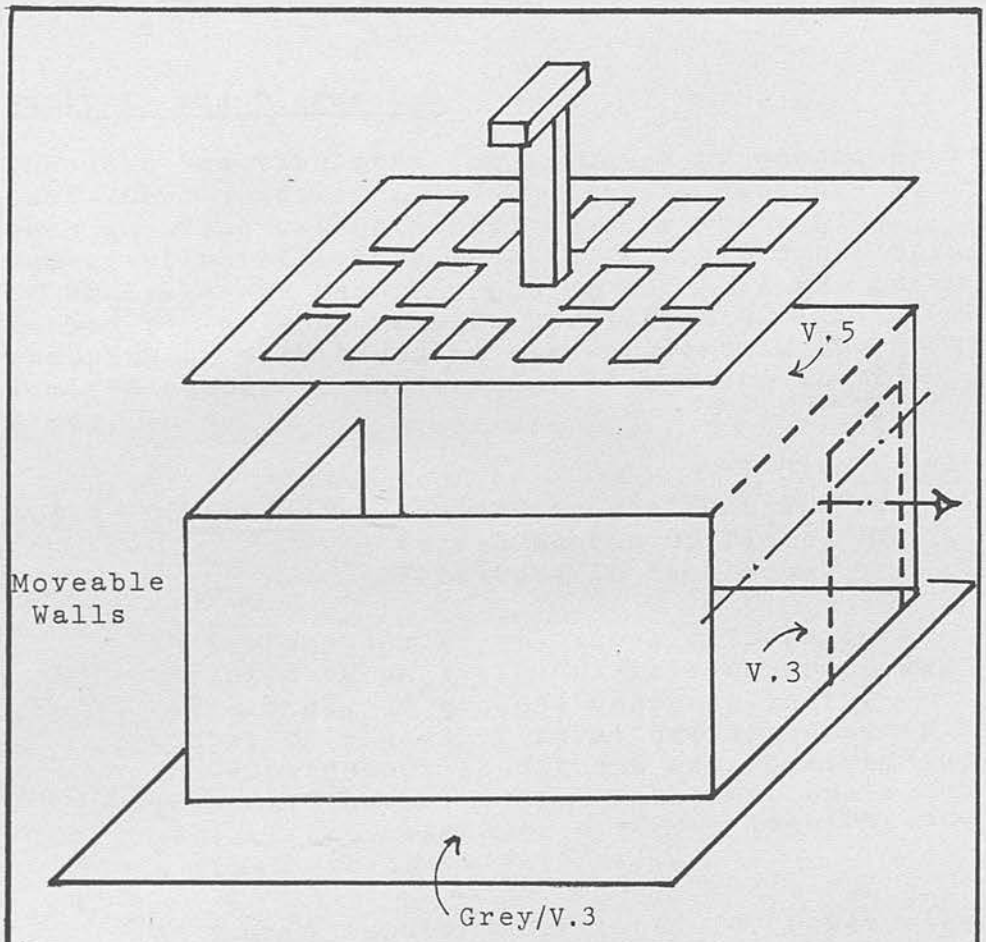
*A full scale room in which the subject could actually experience the space would be the preferred stimulus. However, the practical considerations of time and money involved in building such stimuli were prohibitive. The experiment was further complicated by the investigator's desire to use office workers as the subjects. To accomplish this, the investigator had to make frequent visits to various offices which, in turn, required a portable physical stimuli that could easily be carried and presented.



WALLS	FLOOR	CEILING
WHITE	GREY/V.3	WHITE
BLUE/V.5	GREY/V.3	WHITE
RED/V.5	GREY/V.3	WHITE
YELLOW/V.5	GREY/V.3	WHITE

6.1 Diagram Of The Model

6.5 Analysis And Discussion

The data was tabulated for a number of questions in each colour condition, and an average response to each question was gathered. Due to the small number of participants in each group no other form of analysis was made. Grouping of data was performed for male and female participants, but grouping of data based on age was ignored due to the limited number of subjects participating in this study.

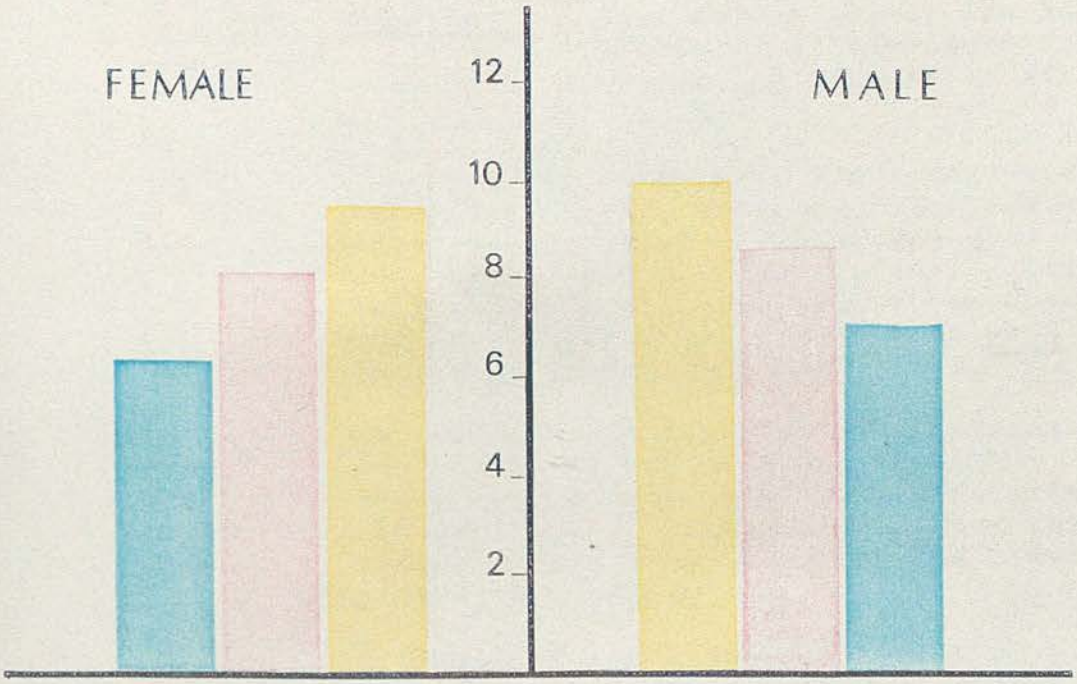
6.5.1 Question 1: Would Colour Affect The Preferred Number Of Pieces Of Furniture In Each Room?

An average number of pieces of furniture arranged by participants in each group was calculated. A gradual decrease in the number of pieces of furniture selected in the four colour conditions was observed in responses gathered from male and female subjects. The responses were put together and a final average was made.

An overall tendency was found for fewer pieces of furniture in the red and blue rooms. However, further studies are needed to not only examine the preferred number of pieces of furniture based on the hue of the room, but also the affect of value and chroma in similar studies.

	FUNITURE NUMBER				
	S_s	WHITE	YELLOW	RED	BLUE
FEMALE	1	11	9	9	7
	2	11	11	8	8
	3	12	10	9	7
	4	9	10	8	6
	5	9	10	8	8
	6	10	9		6
	AVERAGE	10.3	9.8	8.4	6.25
MALE	7	10	10	8	7
	8		10	10	8
	9			8	7
	10			9	6
	11				
	AVERAGE	10	10	8.75	7
		10.15	9.9	8.57	6.62

Table 6.2 - Number Of Pieces Of Furniture Used In Each Room.



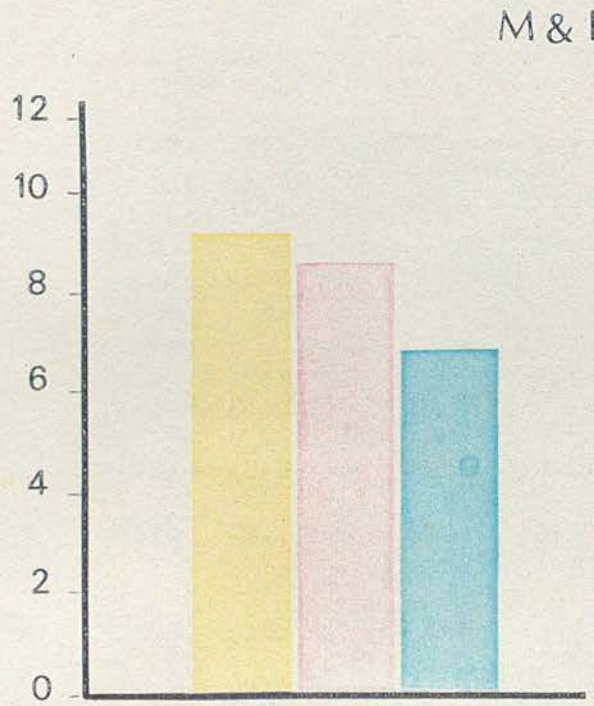


TABLE 6.3 HISTOGRAM ILLUSTRATING RESPONSES TO Q-1

6.5.2 Question 2: Does Colour Affect The Number Of Pieces Of Furniture In The Lounge And Work Areas Within A Room?

Two types of work-space and lounge-areas were consistently selected. Table 6.4 presents the types of furniture used in each area. Two furniture items, a filing cabinet and a bookcase were often used in the area where a transition from work space to lounge area took place.

An analysis was made in order to examine if the colour of the room had any affect on the number of pieces of furniture selected for each area. Table 6.5 presents this analysis, and a histogram of the result is presented as Table 6.6.

A change of the preferred number of pieces of furniture for each area per colour condition can be observed. For example, female participants, on average, preferred more furniture for the lounge-area in the yellow room and a higher number of pieces of furniture for the work-space in the red room.

Male participants, on average, preferred more pieces of furniture for the work-space than for the lounge area regardless of the colour of the room. However, an exception was observed in regard to the red room! Here, the male subjects preferred slightly higher numbers of pieces of furniture for the lounge-area than the work-space.

This study raises a few questions.

(1) If colour does affect the preferred number of pieces of furniture;

(2) And if it does, would the preference for more furniture for certain activities be an indication of the desired mood under such colour scheme. For example would men's reaction to the colour red mean that they prefer a more social atmosphere than a working one in room whose dominant colour is red?

(3) Since female responses varied under each colour condition, would this mean that women are more sensittive and responsive to colour?

(4) If so, is it the cultural up-bringing of male and female or other physiological differences, which makes them respond to colour in different degrees?

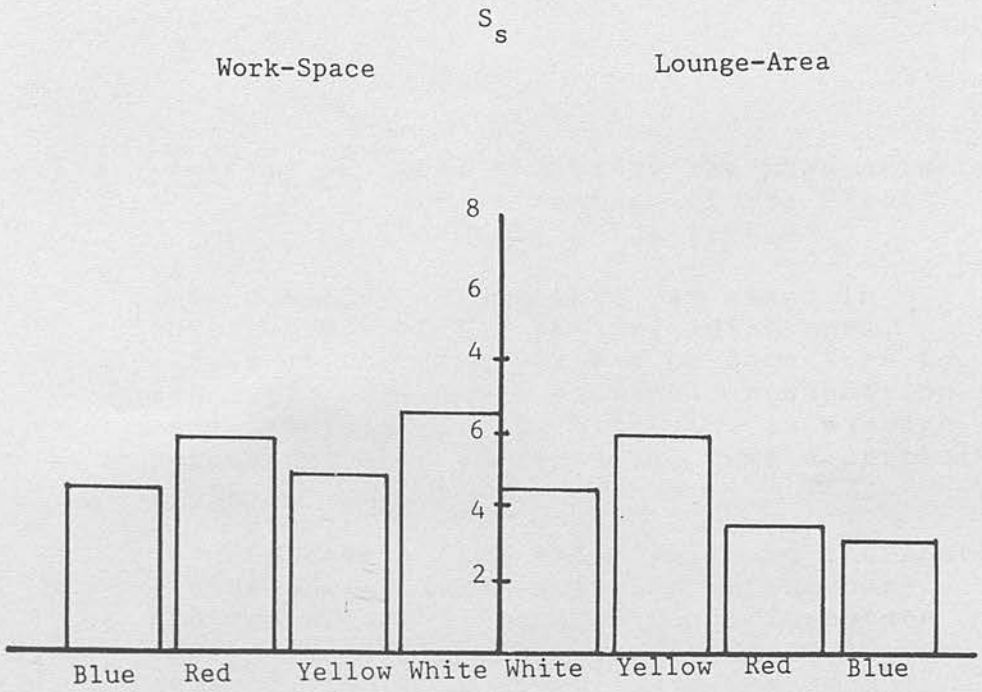
However, the main question is, does colour really affect the preferred number of pieces of furniture with space? This question cannot reasonably be answered without further evidence. However, there is no doubt that studies of this nature can provide us with a great deal of valuable insight which can assist the architect and interior-designer in their design decision making.

Lounge Area	Work Area
Lounge Chair Lounge Table	Desk Desk-Chair Guest-Chair
Filing Cabinet Bookcase	

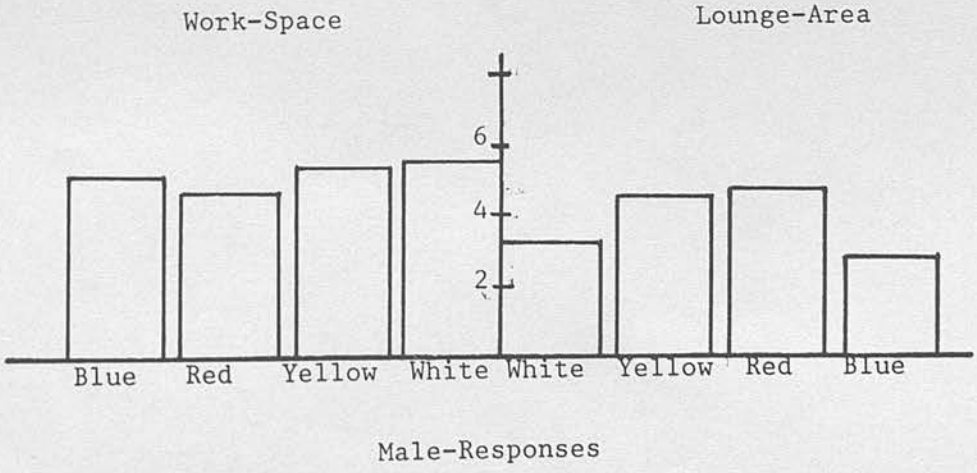
Table 6.4 Types Of Furniture Used By The Participants During Arrangement Of The Room.

Number Of Pieces Of Furniture Per Work/Lounge Area								
S_s	Work Area				Lounge Area			
Female	White	Yellow	Red	Blue	White	Yellow	Red	Blue
1	7	6	3	4	4	5	5	3
2	7	5	6	4	4	5	2	4
3	5	4	6	3	5	6	4	4
4	8	4	5	4	4	6	4	4
5			7	5			3	3
6				5				2
Average	6.8	4.8	5.4	4.2	4.3	5.5	3.6	3.3
Male	White	Yellow	Red	Blue	White	Yellow	Red	Blue
1	5	5	3	6	4	4	6	1
2	7	4	3	4	3	4	5	4
3	5	8	5	2	3	2	3	5
4		7	5	5		2	4	2
5		4		5		5		3
6				5				1
Average	5.6	5.6	4	4.5	3.3	4.4	4.5	2.8
Total Average	6.2	5.2	4.7	4.3	3.8	4.9	4.0	3.0

Table 6.5 - Average Responses Of Male And Female Subjects To Question 2.



Female Responses



Male-Responses

Table 6.6 - Histogram Of The Responses To Question 2.

6.5.3 Question 3: Does Colour Of The Room Affect The Percentage Of The Floor Covered By Furniture?

This question essentially was asked in continuation of the two preceding ones. Ratios of the area covered by furniture to the total area under each colour condition were tabulated (Table 6.7), and an average percentage made for male and female participants.

An observation from this table and the photographs showed some variation in the percentage of the floor covered by furniture under different colour conditions. A tendency for more floor space can be particularly observed in a blue room. Obviously further studies are needed to lend support to this finding. If this hypothesis does prove to be true, would this mean that particpants tried to make the space look more open in a blue room by placing the furniture further apart? Or, would this mean that a desire for a larger personal distance is being expressed under such a colour scheme? And, again, does this mean that a formal and distance atmosphere can be enhanced by selection of a particular colour?

The histogram presented in table 6.8 shows that more floor area has been selected for a blue room. To further examine this, more enquires were made in relation to the positioning and distance of the desk-chair and the lounge-chair (visitors-chair).

(See Question 4 and 5).

% Of The Area Covered By Furniture To The Total Area				
S_s	White	Yellow	Red	Blue
F 1	34%	34%	30%	24%
2	36%	38%	27%	29%
3	36%	36%	28%	24%
4	29%	32%	32%	23%
5	39%	30%	27%	27%
6	28%	28%		27%
7		30%		25%
8				26%
Average	33%	32%	28%	25%
9	32%	33%	29%	27%
10		32%	30%	25%
11		31%	29%	29%
12			31%	24%
Average	32%	31%	29%	26%
Total Average	32.5%	31.5%	28.5%	25.5%

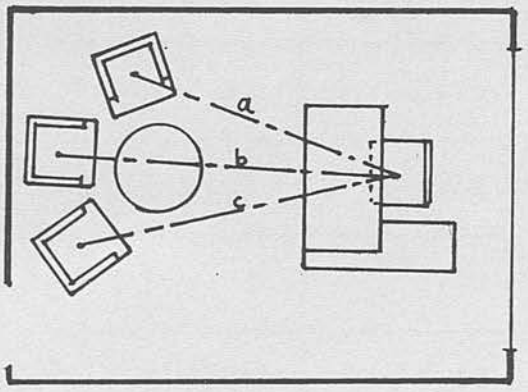
Table 6.7 - Percentage Of The Area Covered By Furniture To The Total Floor Area Under Different Colour Conditions.

6.5.4 Question 4: Does Colour Affect The Preferred Distance Between Desk-Chair And Lounge Chair?

An average distance between desk-chair and the lounge chair was calulated for each subject. The following figure illustrates the method by which average distance was obtained.

$a + b + c = X$

$X \div 3 =$ Average Distance



In general, female participants show a tendency to put a smaller distance between themselves and the visitor's seat in a red and yellow room, whereas, a larger distance was preferred by the male subjects in this red room, see Table 6.8.

Even though the difference between the preferred average distances in each room seems very subtle, it illustrates a possible influence of colour on human behaviour and the personal space that might be desired under various colour conditions. The small differences that were observed here could be due to the small number of participants or the lack of any relevancy to that which was being investigated. The answer would depend on future research.

Chair-Desk Distance From Lounge Chair				
S_s	White	Yellow	Red	Blue
Female 1	4.00	3.00	3.75	4.00
2	3.15	3.00	3.50	3.75
3	3.50	3.00	3.25	4.50
4	3.50	3.75	2.00	2.75
5	3.75	3.00	2.00	4.50
6	3.50	2.25	3.00	3.75
7	3.50	3.00		
Average	3.55	3.00	2.9	3.9
Male 8	3.75	3.25	3.25	4.00
9		2.50	3.75	3.50
10			4.00	3.25
11			4.25	
Average	3.75	2.9	3.8	3.5

Table 6.8 - The Average Distance Between Desk-Chair And The Visitor's Chair Preferred In Each Room By Male And Female Particpants.

6.5.5 Question 5: Does Colour Affect The Positioning Of The Desk-Chair To The Lounge-Chair?

This question examines the nature of eye contact under various colour conditions. An analysis was made in order to see whether direct or indirect eye contact was preferred with a particular colour; and if so, does it mean a direct or indirect form of communication can be enhanced by using certain colours?

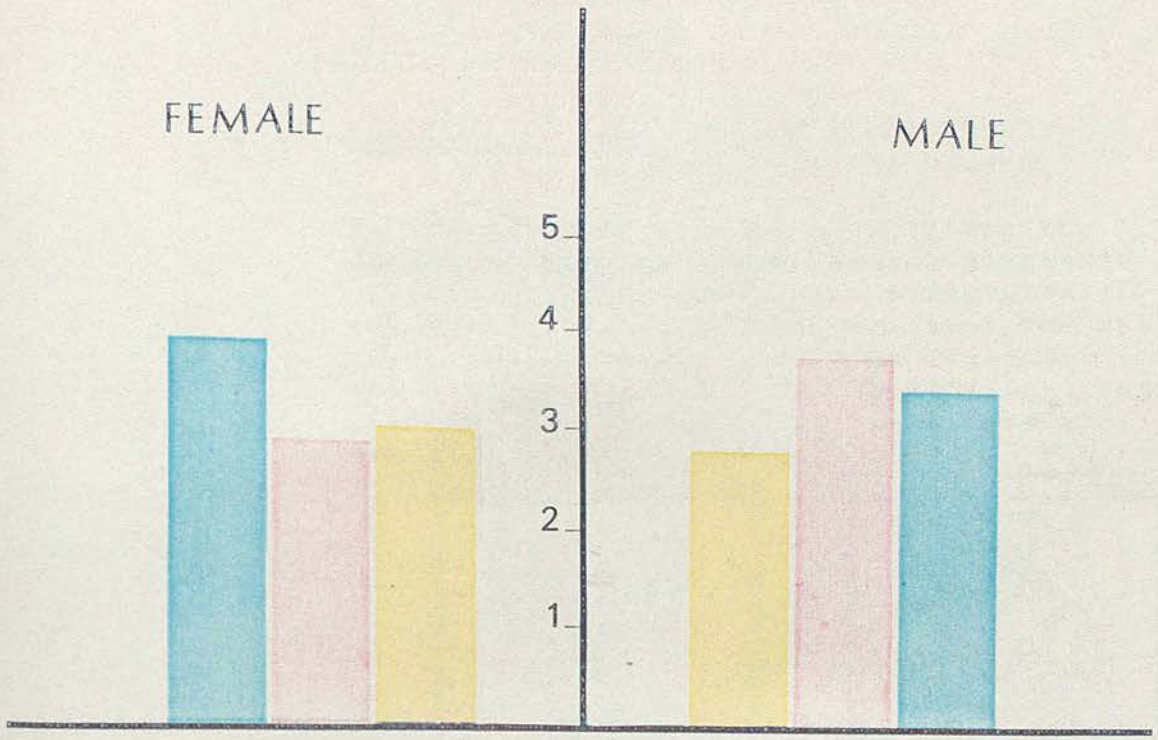
No apparent difference was observed based on the colour condition except that a strong tendency was observed among the female subjects to prefer direct eye-contact with visitors in a yellow-room. It is interesting to note that a tendency was also expressed by the same subjects for the smallest average distance between the desk-chair and visitor's-chair in the yellow room.

Desk-Chair Position To Lounge-Chair								
Subjects	White		Yellow		Red		Blue	
	D	I	D	I	D	I	D	I
1		F	F		F		F	
2		F	F			F		F
3	F		F		F		F	
4		F	F			F	F	
5	F		F		F			F
6	F			F		F		F
7	F		F		F		F	
8				M		M		F
9				M	M			M
10						M		M
11					M		M	
Total	4	3	6	3	6	5	5	6

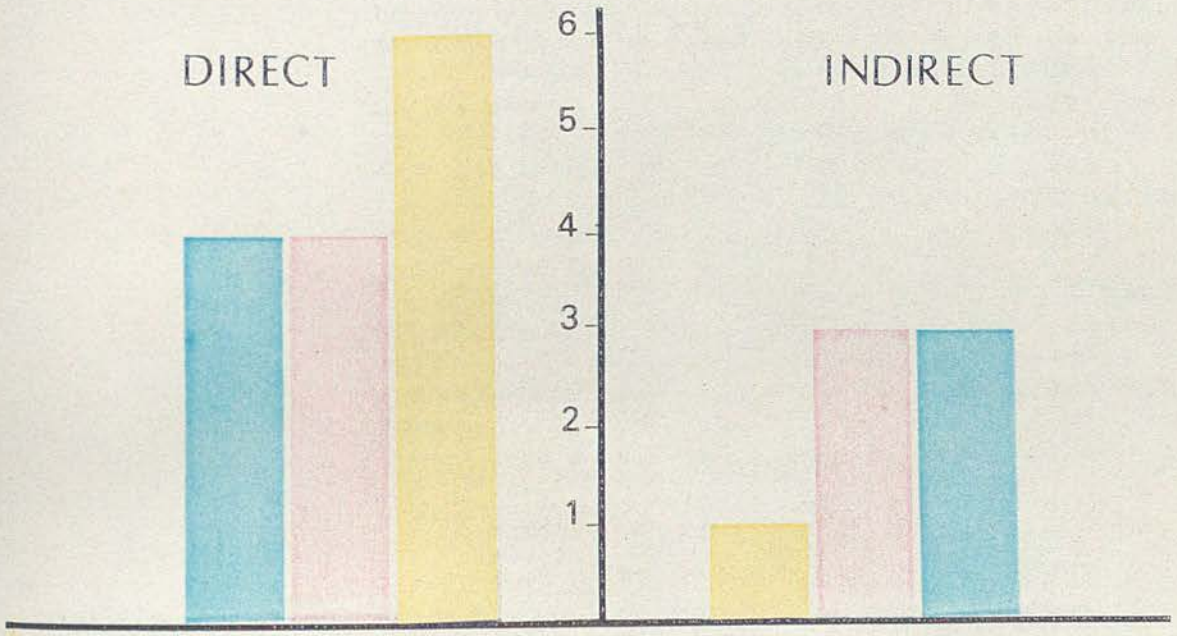
Table 6.9 - Desk-Chair Position To The Lounge Chair For Male And Female Participants.

Direct Eye Contact = D

Indirect Eye Contact = I



Q-4



Q-5

TABLE 6.10 PRESENTS THE HISTOGRAM ILLUSTRATING THE RESPONSES TO Q-4 & Q-5

6.5.6 Question 6: Does Colour Affect The Pattern Of Furniture Arrangement?

An analysis was done by calculating the number of regular and irregular furniture patterns in each room. The definition of a regular furniture pattern was that the main furniture (desk) be placed at right-angles to the wall, (Figure A). Similarly, an irregular pattern was defined as when the desk was set at a slant to the wall, (B).

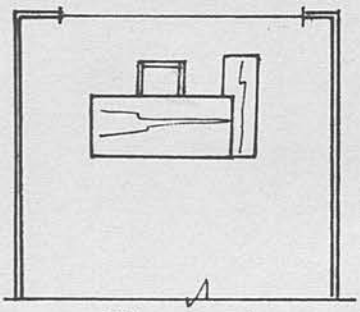


Figure A.

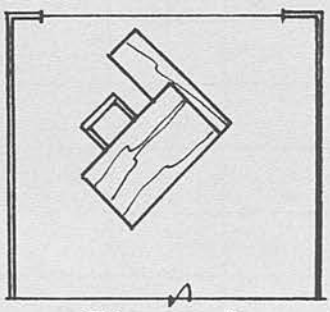


Figure B.

Observation of Table 6.11 shows some difference between the responses to each room. X^2 method of analysis was employed to the total responses, and only a significant point above .20 was found. This might be considered as a positive indication of the existence of an interaction between furniture arrangement and the colour of the surroundings.

In general, an irregular and informal pattern of arrangement was used in red and yellow rooms, whereas a more formal and regular arrangement was preferred in white and blue rooms.

Subjects	Furniture Pattern							
	White		Yellow		Red		Blue	
	R	I	R	I	R	I	R	I
1	1F			1F		1F	F	
2	1F			1F		1F	F	
3		1F		1F		1F	F	
4	1F		1F	1F	1F		F	
5	1F			1F		F	F	
6	1F		1F		1M		F	
7		1M		1M	1M			F
8			1M			M		F
9			1M		1M			M
10							M	
11								M
Total	5	2	4	6	4	5	7	4

Table 6.11 - Preferred Arrangement In Each Room.

Formal/Regular = Desk Right Angled To The Wall = R

Informal/Irregular = Desk Slanted To The Wall = I

Female = F Male = M

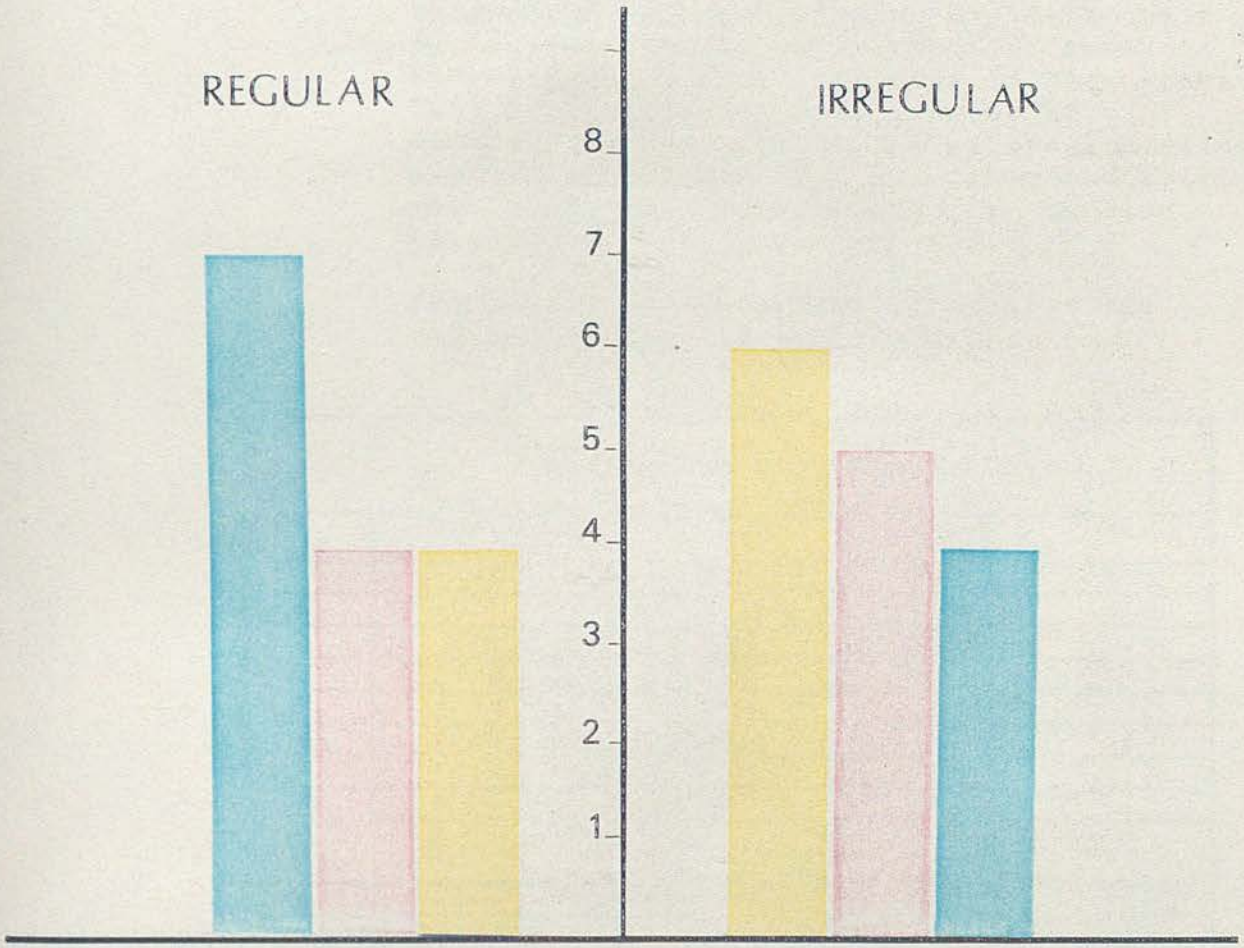


TABLE 6.12 HISTOGRAM ILLUSTRATING THE TOTAL RESPONSES TO Q-8

6.5.7 Question 7: Does Colour Affect The Position Of The Desk-Chair To Door?

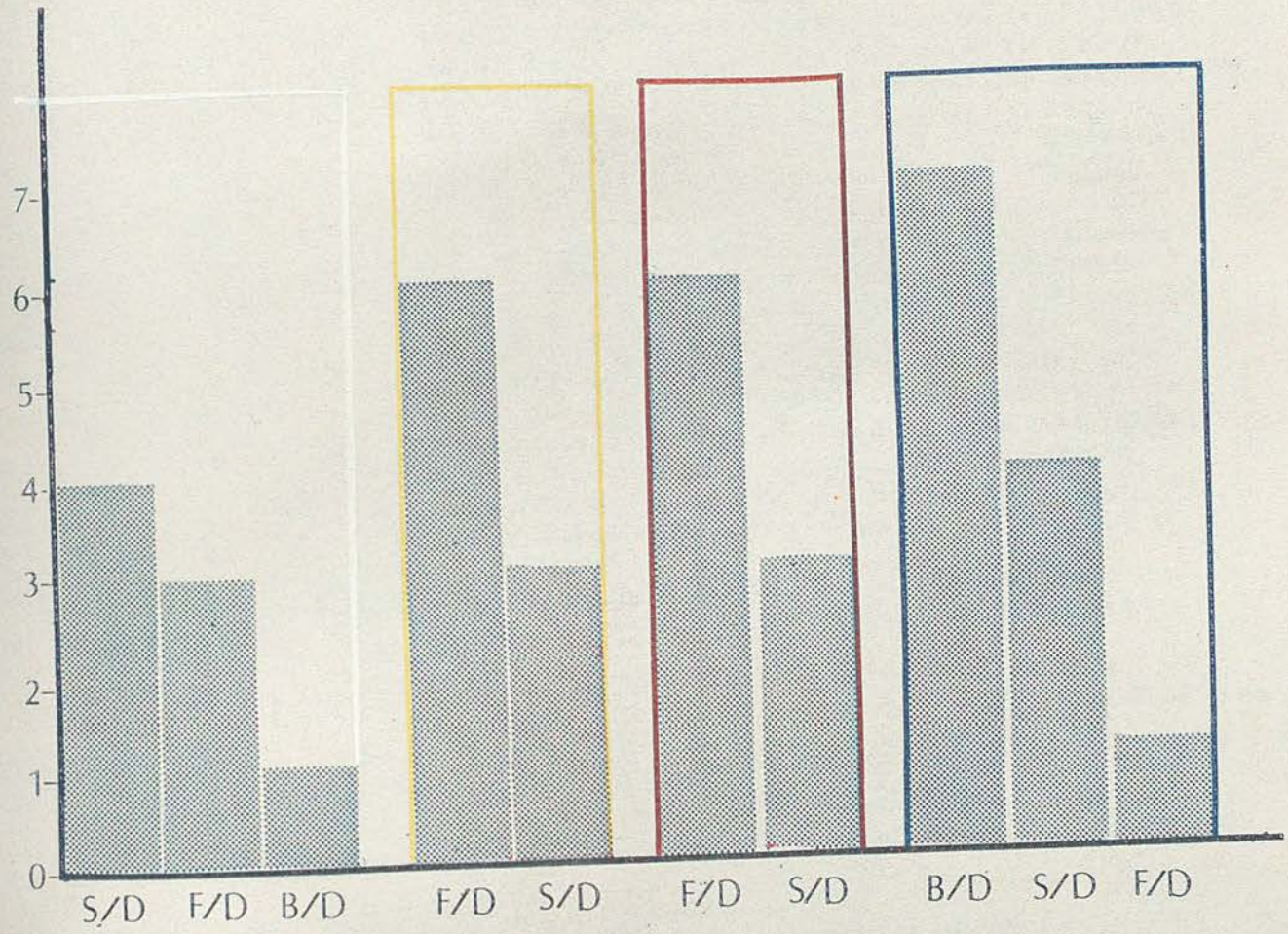
Data tabulated in Table 6.13 shows a tendency towards positioning the desk-chair facing the door in yellow and red rooms, and with the back to the door in blue rooms. This might indicate that a sense of friendliness and/or welcome exists in yellow and red rooms, and that a serious and solemn mood might have been created by the blue colour.

The following histogram illustrates the total responses to this question.

	Desk-Chair Position To Door			
S_s	White	Yellow	Red	Blue
1	S/D	F/D	F/D	B/D
2	S/D	F/D	F/D	S/D
3	F/D	S/D	F/D	F/D
4	S/D	F/D	S/D	S/D
5	F/D	F/D	S/D	S/D
6	F/D	S/D		B/D
7	S/D	F/D		B/D
8				B/D
Male				
9	B/D	F/D	S/d	B/D
10		S/D	F/D	S/D
11			F/D	B/D
12			F/D	B/D
Total	4-S/D 3-F/D 1-B/D	6-F/D 3-S/D	6-F/D 3-S/D	7 B/D 4-S/D 1-F/D

Table 6.13 - Preferred Position Of The Desk-Chair To Door.

Back To Door = B/D
Side And Slanted To Door = S/D
Facing Door = F/D



BACK TO DOOR.....B/D
SIDE TO DOOR.....S/D
FACING DOOR.....F/D

TABLE 6.14 ILLUSTRATES THE TOTAL RESPONSES TO Q-7

6.5.8 Question 8: Does Colour Affect The Positioning Of The Work-Area In A Room?

It was decided by the investigator to mark the centre point of the desk-chair as the heart of the work-area. The vertical and horizontal axis of the floor were drawn, and the location of work-area was marked for each colour condition. For reference purposes the four quadrants were numbered as 1, 2, 3, and 4.

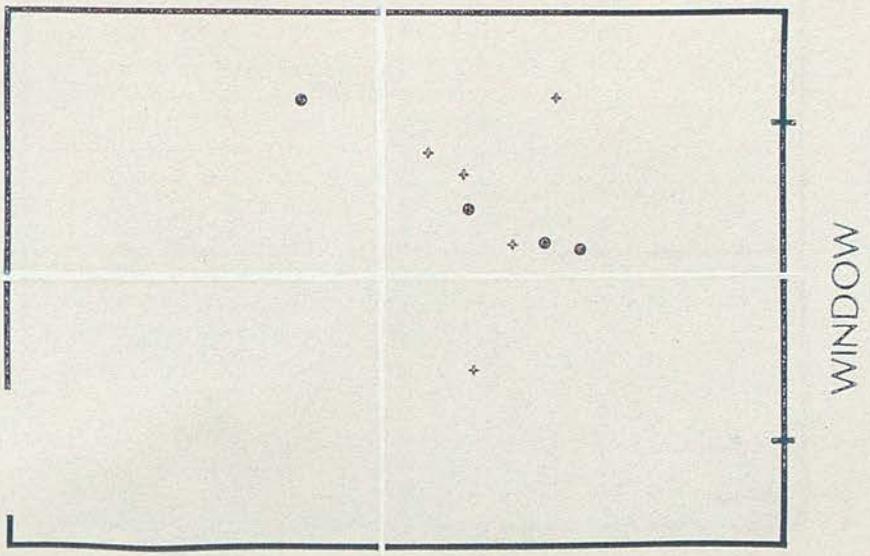
It is interesting to note that a tendency for a different preferred quadrant was observed in each room. Quadrant 3 was more popular in the white room, whereas the preferred work-area was spread over the 2nd and 3rd quadrants in the yellow room. Quadrant 2 was preferred in the red room, and 1 in the blue room. For apparent reasons quadrant 4 was never selected for work area, (see Table 6.15).

6.5.9 Question 9: Does Colour Affect The Preferred Height Of Ceiling?

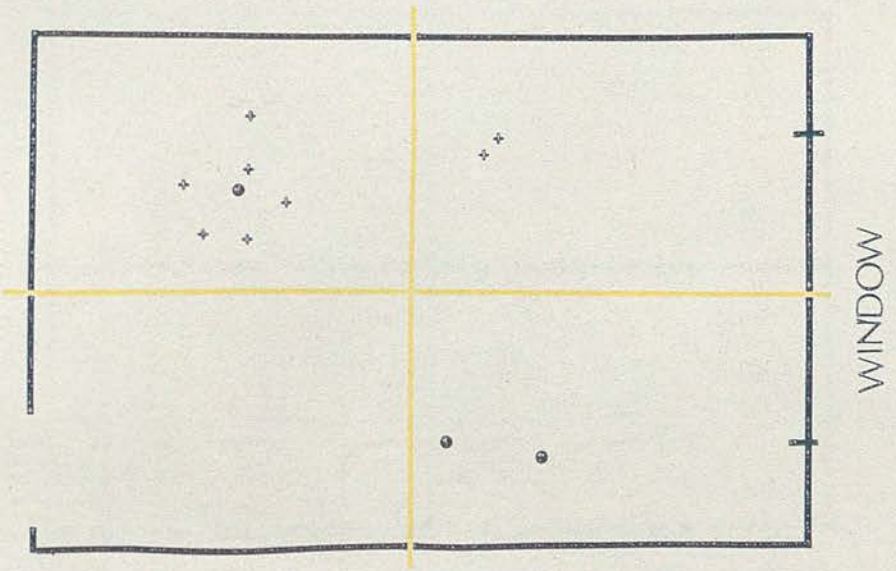
At the end of the arrangement of the furniture, the subject was asked to view the room at the eye level and select the ceiling height by using the moveable ceiling provided. The selected ceiling height was then measured. This data is presented in Tables 6.16 and 6.17.

Male participants generally preferred a higher ceiling. However, both male and female preferred the highest ceiling in the blue room.

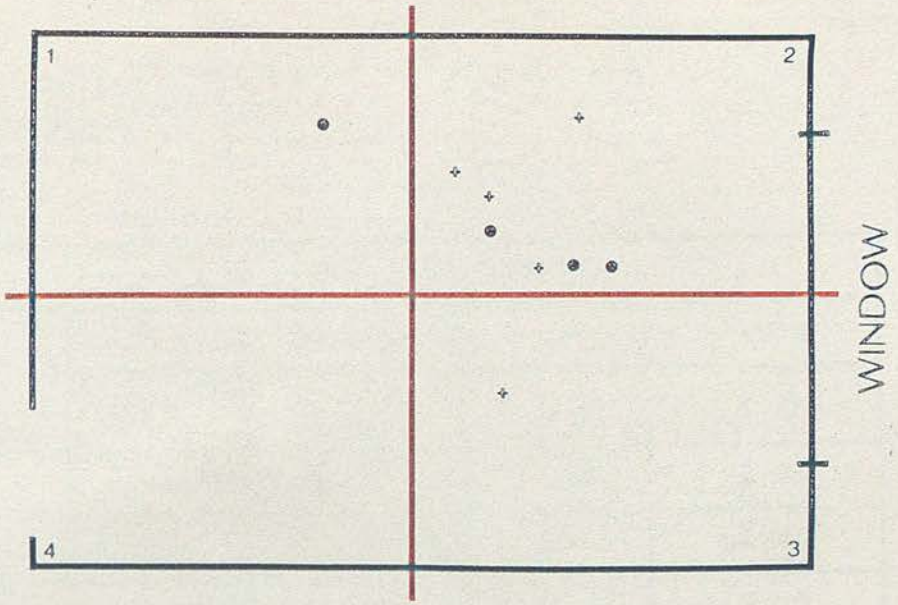
It is interesting to note that males preferred the lowest ceiling height in the red room. As for the females, a general preference for low ceilings was observed. In general, the lowest ceiling was preferred in the white room and the highest in the blue room.



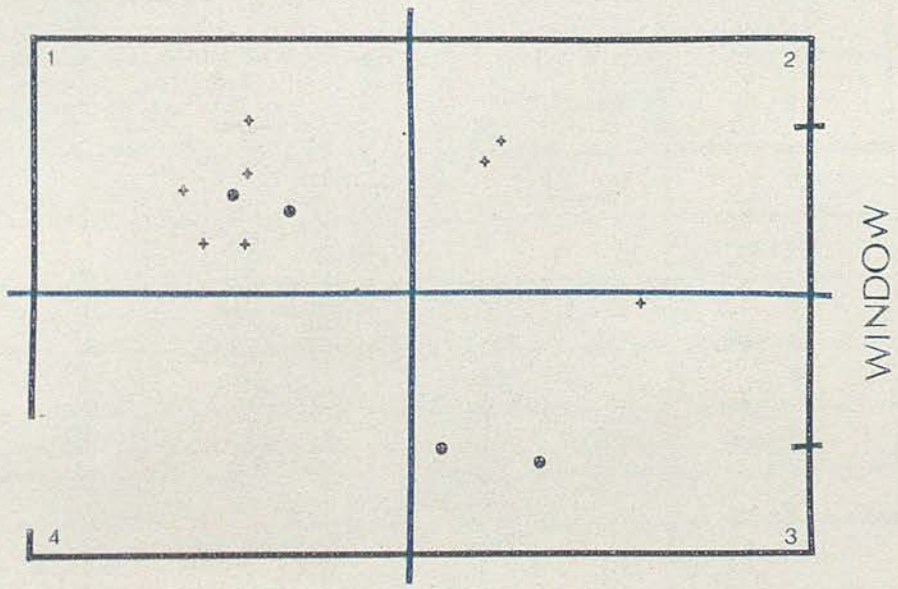
WHITE ROOM



YELLOW ROOM



RED ROOM



BLUE ROOM

TABLE 6.15 POSITIONING OF THE DESK-CHAIR IN THE ROOM WHEN THE WALL COLOUR IS VARIED - Q-8

	Ceiling Height			
S_s	White	Yellow	Red	Blue
1	2.75	2.45	3.0	3.50
2	2.52	2.32	2.9	2.75
3	2.65	3.10	3.1	2.90
4	2.50	2.23	2.6	3.15
5	2.45	2.60	3.5	3.00
6	2.10	3.4		3.00
7		2.8		2.95
8				3.05
Average →	2.49	2.7	3.02	3.03
9	3.10	3.20	3.04	3.45
10		3.10	2.95	2.97
11			2.79	3.9
12			3.10	2.95
Average →	3.10	3.15	2.97	3.31

FEMALE

MALE

Table 6.16 - Preferred Ceiling Height In Each Room.

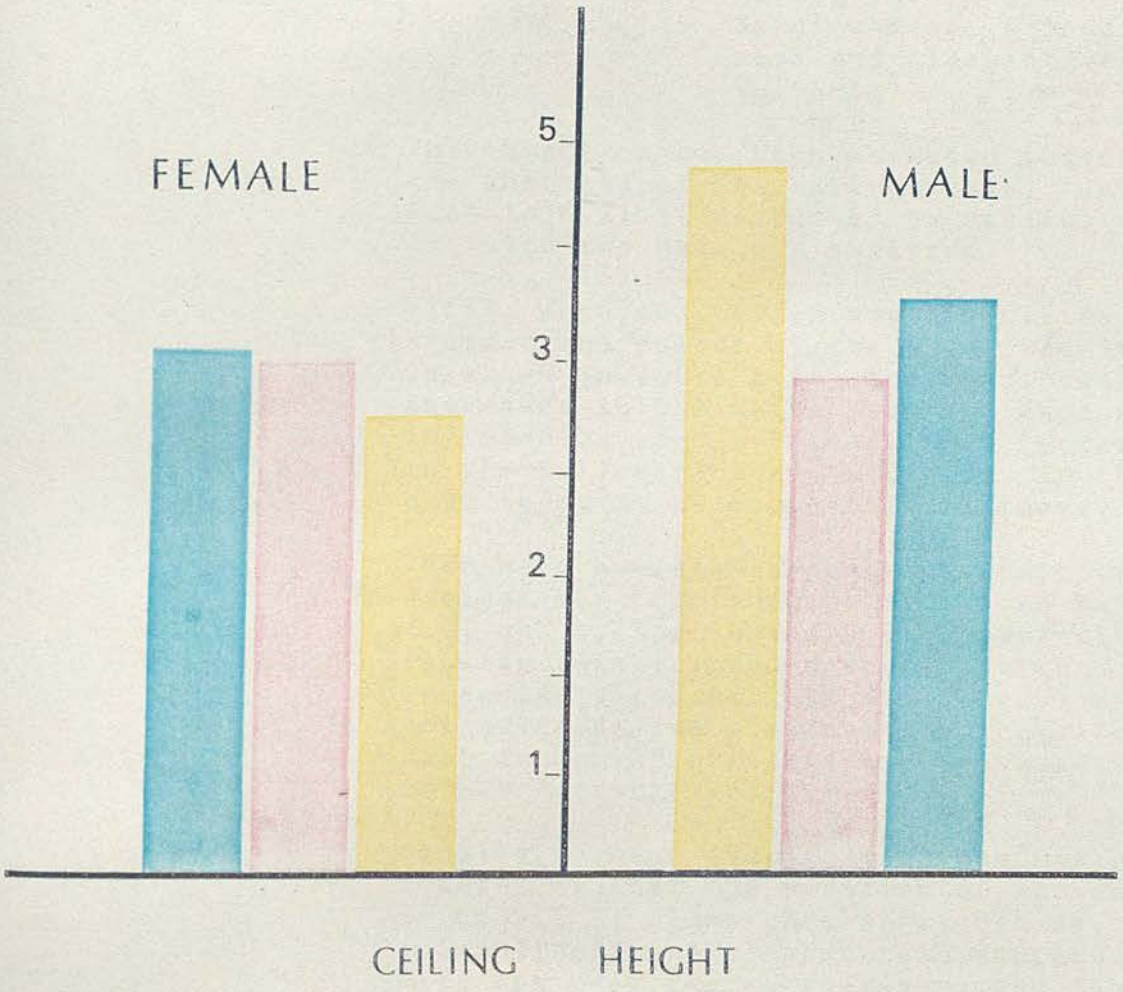


TABLE 6.17 PRESENTS HISTOGRAM OF MALE & FEMALE RESPONSES TO CEILING HEIGHT

6.5.10 Question 10: A) Does Interaction Of Colour And Furniture Arrangement Affect Communication?

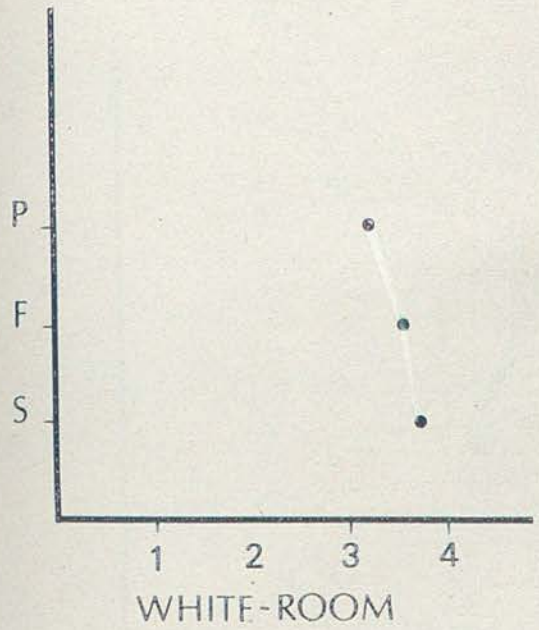
B) Does Colour, Furniture Arrangement And Density Affect The Judgement Of Spaciousness, Friendliness And Pleasantness Of The Room?

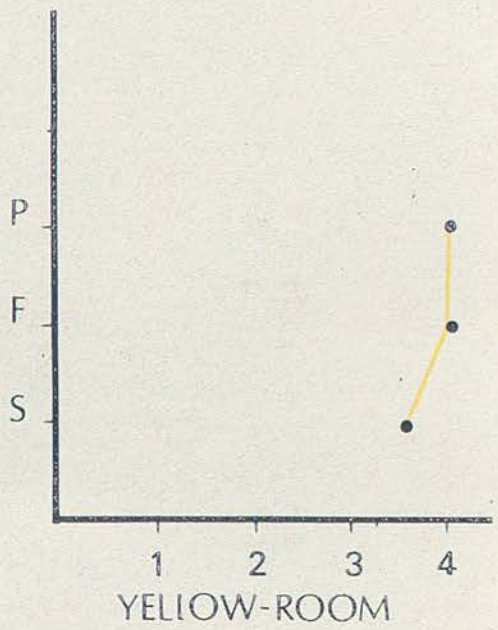
This question has been answered through the analysis of the rating scale. Table 6.18 to 6.21 illustrates the various ways in which the data was analysed.

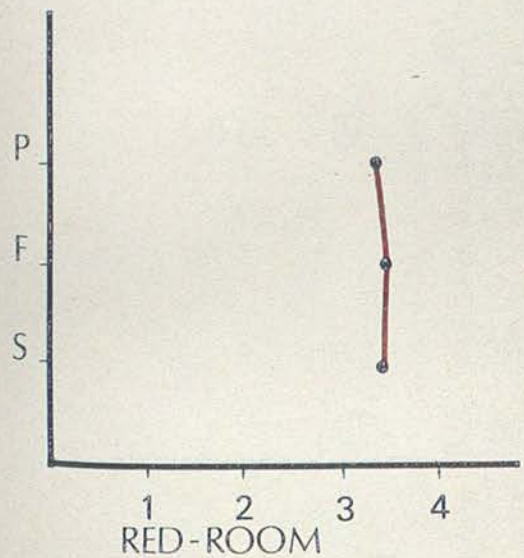
First, mean evaluation was calculated against the colour of the room. As it is shown in Table 6.19 the spaciousness increases in the white room and decreases in the blue room. Friendliness increases in the yellow room and decreases in the blue room, as also does pleasantness.

Then mean average response was calculated against the furniture pattern. As Table 6.20 shows, spaciousness increases with regular patterns and decreases with irregular patterns. On the other hand, friendliness and pleasantness increase with irregular patterns and decrease, with regular arrangements.

Finally, a mean average response was calculated against the position of the desk to door. It seems that spaciousness, friendliness and pleasantness increase with the desk facing the door, see Table 6.21.







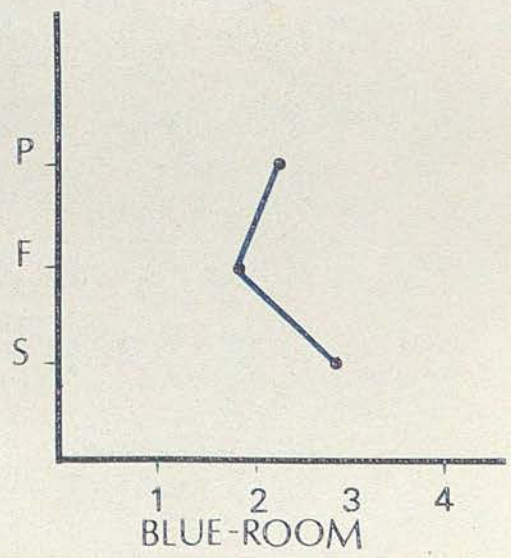


TABLE 6.18 PRESENTS THE MEAN EVALUATION OF SPACIOUSNESS, FRIENDLINESS & PLEASANTNESS AGAINST 4 COLOUR CONDITIONS

S= SPACIOUSNESS

F= FRIENDLINESS

P= PLEASANTNESS

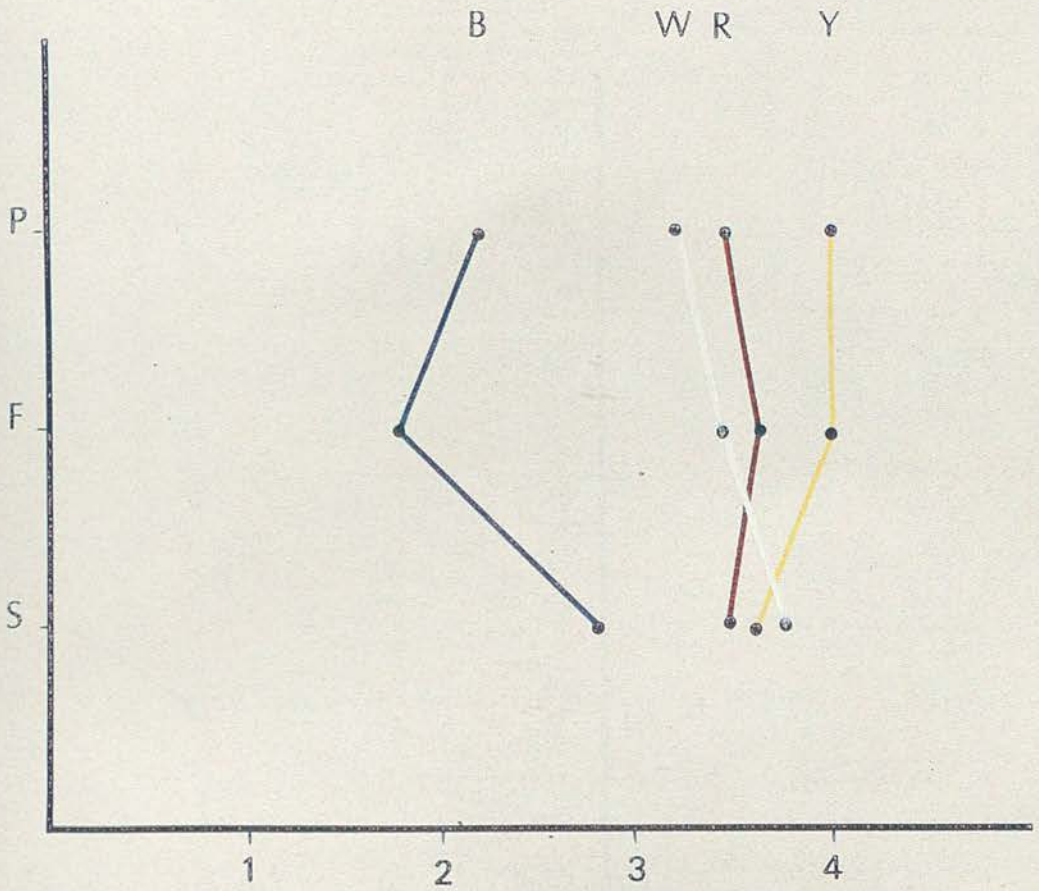


TABLE 6.19 PRESENTS THE MEAN EVALUATION AGAINST 4 COLOUR CONDITIONS

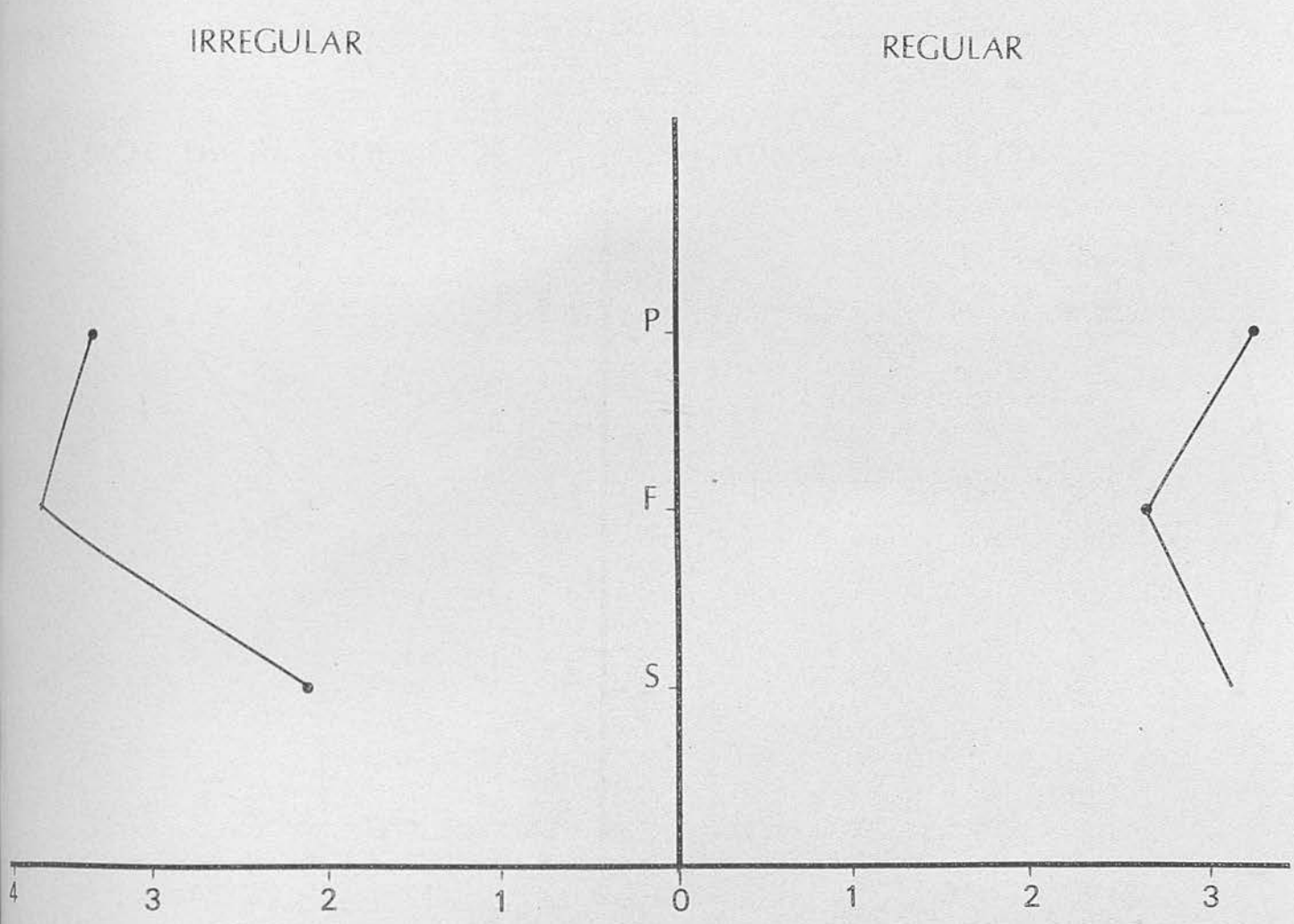


TABLE 6.20 PRESENTS THE MEAN AVERAGE RESPONSES TO THE FURNITURE PATTERN

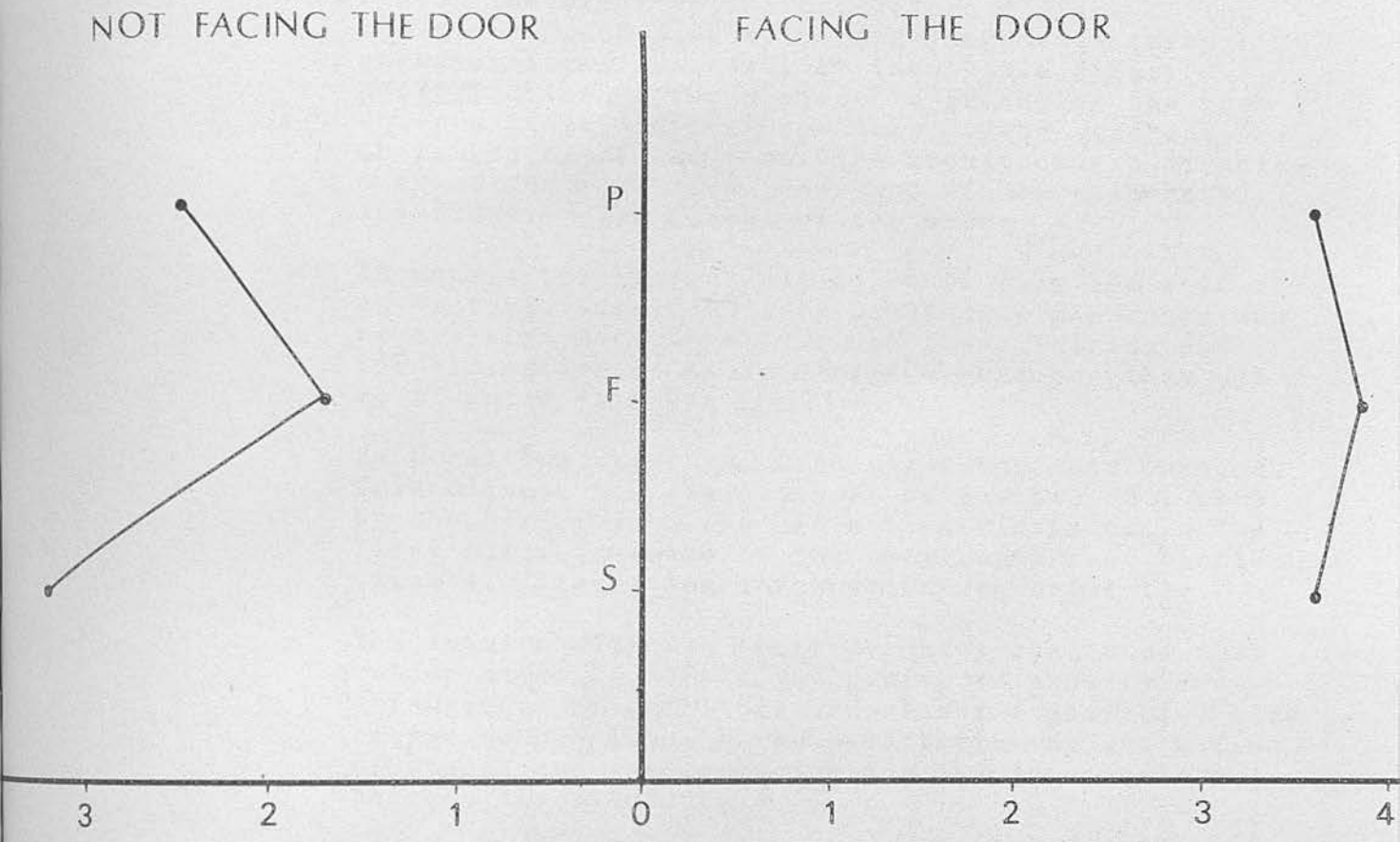


TABLE 6.21 POSITION OF THE DESK TO THE DOOR

6.6 Discussion

The experiments reported here have investigated the effect of colour on furniture density and arrangement. The experimental proceedure did not follow the normal method of eliciting judgements through questionnaires. Instead, it involved a direct participation of the subject in arranging the room under certain limitations, namely, the size and shape (Sq.M) of the room, the architectural arrangement of the room (i.e. door and window placement), and finally, the colour of the space.

In short, the subject was asked to play the role of an "interior-designer", to manipulate the space and make design decisions. It was the eliciting and identification of those design descisions that was most wanted in these experiments.

Each setting was then rated regarding spaciousness, friendliness and pleasantness on a scale of 1 to 5 by another subject who had not participated in the first part. In spite of the small number of participants, interesting information was collected.

The results although tentative have suggested that colour seems to affect the preferred density and arrangement of furniture and also the preferred size of the room. This, in turn, affects the evaluation of space, and the communication and interaction between the occupants.*

6.6.1 Communication:

Communication between people, quality as well as quantity, is a major factor in the success or failure of human relationships, especially in an office.

One crucial factor may be the distance at which people interact. Diverse evidence from studies in several distinctly different areas of research, indicates that it may not be possible to hold a fully invovled personal exchange between two or more persons at a physical distance of more than 66 inches (1.67m) face to face.(7)

---

*X^2 was employed to the responses from question seven to question 10. A significant point above .20 was detected.

In the study reported here only the position of the guest chair was in accord with the above number. This item was not a popular piece of furniture and was often left out. One effect of this action was a conscious (or subconscious) attempt at controlling one's territory by replacing the guest-chair with a lounge chair and hence widening the social distance between one's space and the intruder!

Based on the evidence elicited from this study, social distance seems to be affected by the colour of the surrounding environment. (See Table 6.8). Furthermore, the nature of communication (direct or indirect) has also been influenced by the colour-scheme, (see Table 6.12).

To the best of the investigator's knowledge no direct study of the affect of colour on furniture arrangement has been made before. Thus it is difficult to compare directly the results of this study with any other. However, it is interesting to compare the nature of the desk in relation to the door to that of Sommer's study of Optimal Offensive and Defensive Positions.[9] In his study Sommer suggested that during retreat conditions people gravitate to the end wall and also subjects in retreat will face away from the door. On the other hand, during active defense, subjects tend to occupy the front of the room while facing the door.

The majority of the subjects participating in arrangement of the blue room placed their seating position close to the wall, and faced away from the door. It is often suggested that the psychological effect of colour blue is relaxing, reserved and retreating.[10-11] If so, can it be assumed that this hue provides a retreating atmosphere, hence affecting the decision on placement of the seating position, i.e., desk and its chair?

Similarly, yellow and red are believed to be exciting, stimulating, cheerful and aggressive hues. During this experiment the majority of participants positioned their seat near the front wall and faced the door.

If the assumption is proved to be correct by future studies, we can then base our design decisions within some reasonable framework of interaction of colour and furniture arrangement to achieve easier and more productive communication.

6.6.2 Spaciousness:

Studies related to spaciousness can be grouped according to those focusing on exterior spaces[12-13-14], and those on interior spaces. Included among the latter are Inui (1971); V. Imamoglu (1972); Garling (1971); Küller (1967); Holmberg (1967); Lipman (1968); Sommer (1969); Hall (1972) and Williams (1972). These studies are all related to the affect of furniture arrangement on the judgement of sex and spaciousness, or are concerned with visual perception of architectural space.

Due to the nature of the experiment reported here only some indirect comparison between the results of this study and others can be made. For example, in a study of the effect of furniture density on the subjective evaluation of spaciousness, V. Imamoglu (1972) found that both an empty room and an overly furnished one are assessed to be less spacious than a moderately furnished one. In this study of furniture density the white and the blue rooms contained the highest and the lowest number of items of furniture, and yellow and red, the average. In the subjective evaluation of spaciousness of these rooms, blue was considered to be the least spacious interior and yellow the most. This finding seems in accord with that of Imomglu. However, the white room was not considered cramped, even though it contained the most items of furniture. This could be related to the amount of light available in that room.

The participants selected the highest ceiling for the blue room. Can one assume that colour blue was felt too assertive and the subjects tried to compensate for the oppresiveness of the space by pushing the ceiling higher? If so, then the results from this part of this study is in accord with that of Williams' (1972). However, the subject of nearness and recession is full of controversy. It is important to note that the "lightness" is

considered to be the major determinant when it comes to evaluation of openess/closeness of space.

6.6.3 Friendliness:

The affect of the physical environment as it pertains to the emotion of "friendliness" has received some attention in the past decade. Sommer suggests that furniture arrangement influences social interaction and work in homes for aged persons[18]. Argyle (1965) suggests that the eye position of a seated person is the important factor. Other related studies in this subject are Wools, R. (1970); Demos, Zuwaylif (undated), in which the effect of physical surroundings on the assessment of space, and particularly friendliness, was investigated.

In a study by Canter and Wools (1970) the effect of furniture arrangement, window and ceiling on the assessment of friendliness of space was studied. The most friendly room was judged to be that with the sloping ceiling, large windows and seating at right angles. The least friendly was that with the flat ceiling, clerestory window and desk grouping. In the study reported here, spaciousness seems also to increase with furniture at right angles and therefore, the result is in accord with that of Canter and Wools.

6.6.4 Pleasantness:

There have been numerous studies of emotional reactions to colour, such as studies of colour-mood association (e.g. Crane and Levy, 1962); Lawler and Lawler, 1965; Schaie, 1961a, 1961b; Wexner, 1954), Colour-warmth Association (E. G. Kimura, 1950; Wrigh, 1962), and colour preferences (e.g., Choungourian, 1967; Eysenck, 1941; Kearney, 1966; Tinker, 1938). On the other hand, due to the inconsistency of the control on brightness and saturation, there are other studies which show that any hue can be made more pleasurable than another by varying brightness and saturation, (i.e., Norman and Scott, 1952; Guilford and Smith, 1959). In general, they found a positive relation between brightness and pleasure. With "cool" colours, the increase was much more signi-

ficant. Similar interaction was found for chroma, but for most values of various hues, saturation was direct correlation of pleasure.

However, the minimum pleasure rating was often given to low rather than zero saturations.

The brightness that was used in the experiment reported here was of medium to low value and was kept constant for all three colour variables. It was found that the blue room was considered to be the least pleasant, yellow the most pleasant, with red next. This seems in accord with the studies related to brightness/pleasure mentioned above. (Saturation was kept low in this study and constant for all colour variables).

As for hue, it was noted that pleasure associated with a hue varied with value and saturation. However, for the most part, maximum pleasure was reported in the region of green to blue, and minimum pleasure on the green side of yellow. Thus, a typical ranking of pleasantness of hues (at constant saturation and brightness) was: Blue, green, purple, red, and yellow in descending order[35]. The result of the study reported herein is not in accord with the above studies as yellow and red were considered to be the most popular colour as repeatedly reported in present and previous chapters. This could be due to the fact that the context in which colour is presented will affect the judgement of its impression and cannot be judged in pure isolation.

There have been many other studies, all of which support that the way we see things differs according to the social situtation in which we see them, (i.e., Beebe-Center, 1966; Sherif, M., 1935; Golledge, R. G. and Sannaras, 1973; Ittelson, 1973; Nagase, K., 1969). Therefore, the importance of context, the situation or set of pereceptual stimuli within which the stimulus in question is perceived cannot be ignored as this affects the judgement of visual pleasantness.

To the investigator's knowledge there has been no prior study on the interaction of colour and furniture arrangement and its' relation to pleasure, nor on the relationship of furniture arrangement upon the judgement of visual pleasantness. Therefore, most of the comparisons were made in relation to the colour, and not to the furniture nor to the affect of both together. It is hoped that future studies make it possible to evaluate these results in a similar context.

6.7 Conclusion And Summary

This study researched the interaction of furniture arrangement and density and colour of the room. Colour (hue) was introduced on the walls of the room with constant chroma and value. Blue, red, yellow and white were systematically introduced on the walls (an attempt was made to use similar hues and values that were elicited from proceding chapter).

Gaming was used as the method or inquiry. A scaled model of an office room was viewed by four groups of office employees (one subject at a time). The participant was asked to arrange the furniture in the given room (i.e. red room), and then to set the height of the ceiling. This arrangement was then rated by another participant on a scale of 1 to 5 for the judgement of pleasantness, spaciousness and friendliness.

Interesting information was elicited and discussed. A general interpretation of the findings are, however, somewhat complex due to the small number of participants in this study, and the absence of any research along these line. To the investigator's knowledge no study has previously been done to examine the affect of room colour on furniture arrangement. Therefore, a direct comparison of the results of this study has not been possible. Nevertheless, an indirect comparison was made and discussed.

The results of this study suggest that colour seems to affect the arrangement of the furniture and the pattern of communication. In addition it affects the judgement of pleasantness, spaciousness, and friendliness. Further studies are needed to examine the validity of this experiment and also to investigate the interaction of brightness and saturation with furniture arrangement.

CHAPTER SEVEN

CHAPTER VII - CASE STUDY VII: "INVESTIGATION INTO THE EFFECT OF COLOUR ON THE JUDGEMENT OF OCCUPANT"

Case Study VII: "Investigation Into The Effect Of Colour On the Judgement Of Occupant"

7.1 Introduction and Aim

The importance and effect of colour has been illustrated throughout the studies reported in the previous chapters. These findings raised a question in the investigator's mind as to whether the effect of colour extends to such a degree as to influence the judgement of people within a space.

To the investigator's knowledge a direct study of the effect of background colour on the judgement of the occupant has not been performed. Thus, initial study involved a search for evidence that variations in environmental colour condition do (or do not) affect human judgement in some noticeable way. Hence, the study aims for evidence that colour might serve as an environmental cue or signal and that observers might tend to respond or act upon these cues in some consistent way. If so one should be able to find some shared response among the observers as the colour condition varies.

7.2 Selection Of Physical Stimulus Condition

The laboratory presentation of environmental conditions to be judged will, to a significant extent determine the quality and interpretability of the results. For this reason, the settings should be chosen or constructed to be specifically bracket the field of variables that define the area of study. Of course, complex settings involving multiple variables are permissible, and information about such settings is often desired. However, to the extent possible only the environmental variables under invetigation should vary from setting to setting. For example, in colour experiments variations in accoustics, thermal environment, visual pattern and texture, etc., should be minimized. In this way variations in scaling results can be attributed to the variable of interest[1].

Thus, in order to attribute any change of response to hue, only the dimension of hue was varied in this experiment. As this thesis concentrates on collecting information related to the office environment, it was decided to use office employees as the main subjects. Therefore, an attempt was made in writing the questionnaire to have it relate directly to the office environment.

Selection of a reasonably portable physical stimulus enabling the investigator to carry it to different offices was essential. Hence a two dimensional presentation of a man sitting behind his desk in an office interior (setting) seemed to best fulfill this criteria.

A picture of the 'man' published in the study by Canter and Wool (1970) was used in this study. The four hues of red, blue, yellow and gray were used on the background walls as the four colour variables. Value and chroma were similar to those used in studies reported in preceding chapters and were kept constant throughout the experiment. Therefore, any change of response should be attributable to changes in hue (See APP. V-A).

7.3 Procedure

As the investigator began this study she became aware of a number of statistical techniques for evaluating the subjective impression of a space. These techniques are 1) analysis of variance[1], 2) factor analysis[2], 3) multidimensional scaling-MDS[3-4], and 4) various observations and mapping methods[5-6]. The first two methods were preferred as primary techniques, since both techniques provide the information the investigator was initially seeking. Therefore, the first thing to be done was to construct a tool by which responses could be measured against the colour variables. This involved the construction of a "rating scale" which was developed as follows:

7.3.1 Construction of the Rating Scale:

The four physical stimuli were randomly shown to 40 office employees of Scottish origin aged between 22-55 years old. Every 10 subjects (of roughly equal males and females) viewed only one condition (one at a time). The subject was asked to imagine that he/she has applied for a job, and is now being interviewed by the man shown in the picture. The subject was then asked to express his/her first impression of the man by listing a number of descriptive adjectives which expressed their feelings and thoughts (see APP. V-B). The subjects were not told about the purpose of the experiment, however, it is possible that it was guessed by some as the background wall was the only area in which colour was presented. This "free form of response" was used to reduce the extent to which the investigator can impose preconceptions on the experiment.

The adjectives gathered in this fashion formed the basis of the semantic scales in the second questionnaire. Table 1 (Appendix V-C) presents the typical descriptive adjectives gathered from the 40 office employees. Upon initial review, this table illustrates some change of response as the colour of background changes.

29 Adjectives were selected from Table 1 (APP. V-C). The selection of adjectives was based on the repeated use of the words and the investigator's interest in gathering adjectives related to the 3 categories of emotional responses (pleasure, arousal, dominance) discussed in Chapter III. This would facilitate the testing of the two hypothesis 1) the effect of colour on the judgement of the occupant; 2) the existance (or non-existance) of 3 categories of emotional responses to changes in the environment.

The above questionnaire was shown to 96 office employees (male and female, age 22-38). Each subject viewed only one condition and rated his/her response on a scale from 1 to 7 (see APP. V-D). (Each colour was viewed by 24 subjects.) Finally, while developing and using the above questionnaire the investigator also recorded numerous observations of the subjects.

7.4 Analysis

7.4.1 Multivariate Analysis of Variance (MANOVA)

This is a statistical procedure for analyzing a body of data collected in an experiment. It provides information concerning the statistical significance, or lack thereof, of differences between ratings for various experimental settings and rating scales. This includes statistical significance of main effects and interaction effects.

It also provides variability estimates (i.e. standard error of the mean) for each experimental setting on each rating scale. Also provided are tables of mean ratings for each combination of setting and rating scale (see APP. V-E, MANOVA Test). These tables were used for graphical presentations as shown in Table 7.3.

The above information can be obtained using "MANOVA" in SPSS. When the number of dependent variables exceeds one. It is recommended to use "MANOVA" in SPSS which is a generalized multivariate analysis of variance and covariance program. This procedure performs univariate and multivariate linear estimation and tests of hypotheses for any crossed and/or nested design with or without covariates (see SPSS user's guide for more details).

The first test was to check for an interaction effect between sex and room (i.e. hue). No significance was found as the univariate levels of significance varied between .945 on variable 20 (handsome), and .23 on variable 16 (bossy) the multivariate levels of significance between .27 and .31. (See APP. V-E, MANOVA Test, P. 12).

The first main effect investigated was the difference between the responses gathered from male and female participants. This was done by comparing the responses of each sex along each scale. The significance of 'F' ranged from .954 on variable 22 (exciting) to .065 on variable 18 (conservative). In the multavariate design the significance of 'F' was .148. Considering the degree of freedom (1.88) involved in this experiment the results were not significant (see APP. V-E, MANOVA Test, P. 13).

The second main effect tested was difference in responses based on room (hue). The three variables "demanding", "easy to work with", and "tempermental" yeilded a "significance of F" of 0.001. In addition seventeen variables yeilded a "significance of 'F' of less than 0.05. In the multivariate design the significance of 'F' was less than 1×10^{-8}. This result indicates that the subjects' responses to the colour (hue) were not significant for all the variables, but the judgement of the occupants was affected by the colour of the room (see APP. V-E, MANOVA Test, P. 14).

7.4.2 Principal Components Factor Analysis:

This procedure can be utilized to determine subsets of rating scales that are being utilized in similar or consistent ways by the subjects. If more than one rating scale is listed in a given subset, this process identifies scales that are functioning in a redundant manner.

The naming of the factors is not provided. Rather, the investigators must use their ingenuity and/or background knowledge to accomplish this. Generally, an inspection of those rating scales that load highly on a factor will indicate the nature and possible name of that factor[2].

The process of factor analysis is, in its entirety, quite complex and the interested reader is referred to Harman (1967)[2] for a more detailed discussion. In the context of this report, the procedure was used to provide information concerning the intercorrelation and grouping of rating scales.

Although the experimentor was expecting factors along the dimensions of "Pleasure, Arousal and Dominance", the PA1 method of factor extraction was employed in order to avoid dictating any preconceived factors. In this way the hypothesis of these three particular factors could be tested more freely.

To avoid the maximized loading of scales on the first factor, i.e. to maximize the factors along which the scales were loaded, a varimax rotation was used. The 29 x 29 correlation matrix was factor analyzed. There were nine factors with Eigenvalue above unity which accounted for 78.4% of the total variance (see APP. V-F, Factor Analysis, P. 2). Factors from 5 to 9 consisted only of single items and accounted for a small pct. of variance. Therefore, they were not considered for further analysis.

For factors 1 to 4, loadings of .5 and above were selected and are shown in Table 7.1. Those scales with high loadings on more than one factor were rejected as statistical noise (see APP. V-H, Reliability Test For Further Explanation).

The selected scales were refactor analyzed in order to verify that the interrelationships were not effected by the removal of the inconclusive scales (noise). Four factors were obtained with Eigenvalues above 'two', which accounted for 65% of the total variance (see APP. V-G, P. 2). Again, loadings of .5 and above were selected and are listed in Table 7.2.

An examination of Tables 7.1 and 7.2 illustrates that although the same four factors reappeared in both tests, the order of factors (or the relative importance) derived from the first test was changed in the second test. In addition, one variable (uninteresting) appeared in two factors. (This is discussed further in the following pages along with each individual factor.)

FACTOR I - Appears to present an impression that is tentatively named "Control", and is related to the style of work administration. Table 7.3 presents the mean response for each variable on each factor, in each room. It is interesting to note that the impression of "Strict" and '"Conservative" etc., is the strongest in the gray room, but this impression became much weaker in the blue and red room.

FACTOR II - Seemed to be related to the impression of "personal response and stimulation", and is named 'Stimulation'. This factor appeared as the fourth factor in the first test. But, after eliminating the "noise" it became the second strongest factor. It is interesting to note that impressions of feeling such as "exciting", decreased most in the gray room and increased in the red room.

FACTOR III - General impression of "evaluation of pleasantness" are presented by the rating scales that loaded towards this factor. As can be seen in Table 7.3 the impression of all the ratings has been possitively enhanced by the red colour and negatively by the gray colour.

FACTOR IV - The nature of this factor seems ambiguous to the investigator and thus no name has been given to it. It seems that the rating scales on this factor illustrates the antithesis of the scales on Factor III. For example, it seems that "distrustful" can be the opposite of "sincere"; "cold" the opposite of "warm"; and "difficult" the opposite of "easy". Finally, the character of "interesting" is not quite known as it could belong to the pleasure dimension as well as to the arousal factor.

	Factor		Eigen-Value	Pct. of Var	Cum Pct.
I	Sincere	.85503	6.96997	24.0	24.0
	Warm	.77678			
	Easy to Work With	.71659			
	Kind	.57020			
	Pleasant	.53467			
	Honest	.52339			
II	Strict	.79089	4.09698	14.1	38.2
	Conservative	.78472			
	Judgemental	.73557			
	Demanding	.66458			
	Prompt	.64728			
III	Distrustful	.82043	3.26256	11.3	49.4
	Cold	.80565			
	Difficult	.75074			
	Somber	.71765			
	Uninteresting	.56285			
IV	Bold	.81068	2.58974	8.9	58.3
	Sociable	.80604			
	Exciting Personality	.56763			
V	Temperamental	.78611	1.30728	4.5	62.9
VI	Handsome	.63493	1.25791	4.3	67.2

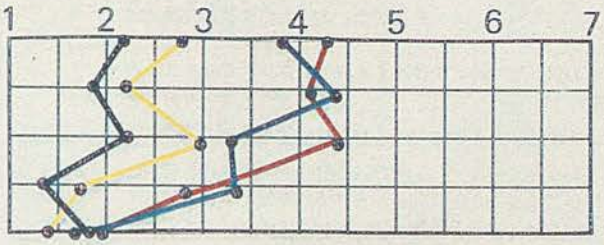
Table 7.1 - Present The Items With .5 Loading And Above On 6 Factors

	Factors		Eigen-value	Pct. of Var	Cum Pct.
I	Demanding	.83376	5.39420	27.0	27.0
	Strict	.81786			
	Judgemental	.73185			
	Conservative	.71794			
	Prompt	.61188			
II	Bold	.78844	3.19044	16.0	42.9
	Exciting	.72906			
	Sociable	.66237			
	Boring	.65122			
	Uninteresting	.55952			
III	Warm	.81619	2.35535	11.8	54.7
	Sincere	.79227			
	Easy to Work With	.77280			
	Kind	.64489			
	Pleasant	.59515			
IV	Distrustful	.80975	2.12546	10.6	65.3
	Cold	.79704			
	Difficult	.78678			
	Somber	.70505			
	Uninteresting	.61957			

Table 7.2 - Presents 4 Factors With Items With Loading Of .5 And Above

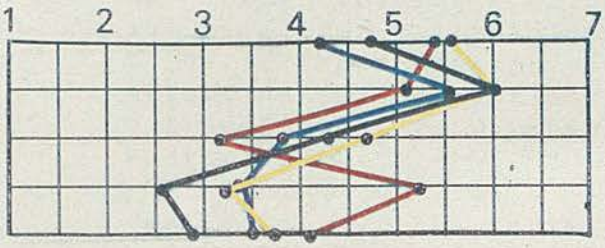
FACTOR I, EVALUATION OF WORK ADMINISTRATION (control)

DEMANDING
STRICT
JUDGEMENTAL
CONSERVATION
PROMPT



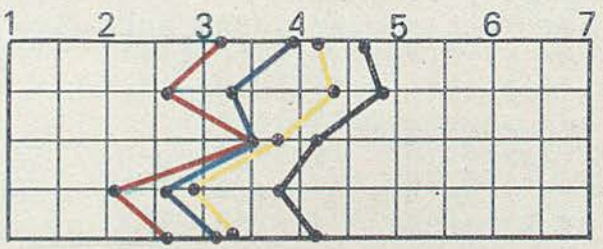
FACTOR II, EVALUATION OF PERSONAL ACTIVITY (stimulation)

BOLD
EXCITING
SOCIABLE
BORING
UNINTERESTING



FACTOR III, VISUAL & PERSONAL EVALUATION (pleasantness)

WARM
SINCERE
EASY TO WORK WITH
KIND
PLEASANT



FACTOR IV,

DISTRUSTFULL
COLD
DIFFICULT
SOMBER
UNINTERESTING

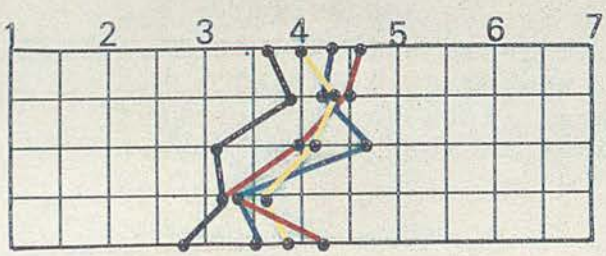


TABLE 7.3 PRESENTS THE MEAN RATINGS FOR FOUR COLOUR CONDITIONS ON EACH FACTOR.

7.4.3 Reliability Test

A test of reliability was performed on the four factors. Factor One, Three and Four initially had a reliability coefficient of greater than .8. In all but one case the variables for each factor decreased the reliability coefficient of the factor if it was deleted. In the one case that this did not happen (V.25 on Factor-1, see APP. V-H P. 3), the increase in the reliability coefficient was only .006. As v.25 (prompt) had a high loading (.61188) on Factor One in the factor analysis, and would be expected to be in the dimension of dominance, its effect on the reliability coefficient was not sufficient to warrant its exclusion from Factor One.

For Factor Two the correlation matrix showed V.3 (boring) and V.15 (uninteresting) negatively correlated to V.10 (bold), V.22 (exciting), and V.28 (sociable). This is due to V.10, 22 and 28 presenting positive cases of the scale, and V.3 and 15 presenting negative cases of the scale. This reliability test uses an additive system of correlation, causing the negative cases to drastically reduce the reliability coefficient. To correct the phrasing of the scales, the following computations were made and analyzed as part of Factor Two.

V.3A=-V3 and V.15A = -V15 (APP. V-H, P. 10)

With this change the measure of reliability for Factor Two improves noticeably and came in line with the other factors tested. The Alpha Coefficient became .78219 and the deletion of any scale from the factor reduced the coefficient appreciably (APP. V-H P. 11).

7.5 Discussion

This experiment suggests that colour variables do induce some consistent and apparently shared impressions for the users. Furthermore, the tests tend to confirm that rating scales may be useful tools for providing insight into this phenomena. However, these are tentative conclusions, and are discussed here simply to demonstrate the potential value of rating procedures as a research device for providing broader insights into questions of the

effects of colour in our lives.

The factors resulting from the factor analysis again support the existence of the three emotional dimensions discussed in Chapter Three. The three factors of "Pleasantness", "Control", and "Stimulation" resulting from this study are very similar to "Pleasure", "Arousal" and "Dominance" suggested by Mehrabian and Russell (1974)[8].

7.5.1 Control (Dominance)

An individual's feeling of dominance in a situation is based on the extent to which one feels unrestricted or free to act in a variety of ways. This feeling can be hampered by settings that limit the forms of potential behaviour and enhanced by settings that facilitate greater varieties of behaviour. As was shown in this experiment this feeling can be enhanced with the colour red (see Table 7.3, Factor 1). However, there is a lack of data on how other physical aspects of the environment affect the feelings of dominance, or how dominance influences approach-avoidance behaviour. A development of this knowledge could in turn facilitate greater personal communication and enhance the relationships among the users of the environment.

7.5.2 Stimulation (Arousal)

Evidence relating to colour and arousal can be found through various studies, some directly and others less directly. Among the direct studies were Erwin, Lerner, Wilson and Wilson's study (1961) who used coloured slides (red and green of approximately equal intensity). It was found that EEG desynchronization (arousal) was significantly greater for red than for green. However, the effects of other colours used in similar experimentation (white, yellow and blue were difficult to assess, due to the variations in their intensity.

Among the less direct studies, Birren (1946)[10] reported that muscular reactions under red light were 12% faster than normal, on the other hand green light had a retarding effect on muscular reaction. In another study, Nakshian (1964)[11] asked his subjects to trace a half-circle with a stylus as slowly as possible; during the experiment subjects were asked to hold a metal rod steadily between two guides, contact with the guides was automatically recorded, hence measuring hand tremor. In both tasks, participants were surrounded by panels of uniform red or uniform gray. It was found that hand tremor and speed of movement was far greater when surrounded by red panels than when surrounded by gray panels. Also, speed of movement increased when gray panels were compared with green panels. In addition, James and Domingos (1953)[12] found that hand tremors were far greater under deep red light than under white light. However, Hammes and Wiggins (1962) did not find any significant effect of red versus blue illumination on a perceptual-motor steadiness task[13].

Colour warmth has also been associated with arousal through indirect studies. For example Seaton (1968)[14] reported a study in which people were found to walk faster in hallways painted in 'warm' colours than in those painted in 'cool' colours. It has been suggested through various studies that the judgement of colour warmth is a shared experience and hence very receivable (Berry, 1961; Hogg, 1969; Newhall, 1941; and Osgood, Suci, and Tannenbaum, 1957)[15 to 18]. In addition, a general hot-cold continuum ranging from red, orange, yellow, violet, blue, to green as the coolest was found by Kimura, (1950)[19]. A direct correlation of saturation and colour warmth suggests that more saturated colours are also more active. This evidence was presented by Wright and Rainwater (1962)[20], and Hogg (1969)[16]. No significant relationship was found in Hogg's study between colour brightness and his activity factor, however, an inverse correlation between brightness and warmth was found in Wright and Rainwater's (1962) studies.

In his studies of visual reaction to colour Birren (1963)[21] states that:

> "Reactions to colour through the eye itself are many, varied and intriguing. In the main, colour effects tend to be in two directions, toward red and toward blue, with the yellow or yellow-green region of the spectrum more or less neutral. Furthermore, these two major colours cause different levels of reaction in the body and brain. Red seems to have an exciting influence".

Kurt Goldstein (1942)[22] writes:

> "It is probably not a false statement if we say that a specific colour stimulation is accompanied by a specific response pattern of the entire organism".

With reference to red, he mentions the case of a woman with a mental affliction who had a tendency to fall unexpectedly. When she wore a red dress, such symptoms were more pronounced. Goldstein points out that tremor, torticollis and some conditions of Parkinsonism "can at times be diminished in severity if the individuals are protected against red or yellow, if they wear, for instance, spectacles with green lenses".

In what is called photogenic epilepsy, a flickering red light is more likely to induce radical brain waves and clinical seizures than other colours. In several cases, wearing eyeglasses which cut off the red end of the spectrum reduced the frequency of clinical seizures, even when medicine was dicontinued. With infants who had no prior experience with colour, Josephine M. Smith noted that blue light tended to lessen their activity and crying[23].

Goldstein, who has worked extensively with colour, concludes:

> "The stronger deviation of the arms in red stimulation corresponds to the experience of being disrupted, thrown out, abnormally attracted to the outer world. It is only another expression of the patient's feeling of obtrusion, aggression, excitation, by red. The diminution of the deviation (to green illumination) corresponds to the withdrawal from the outer world and retreat to his own quietness, his center. The

> inner experiences represent the psychological aspect of the organism. We are faced in the observable phenomena with the physical aspect."

Goldstein also noted that judgement could be affected by colour. The passage of time, for example was likely to be over-estimated under red light and under-estimated under green or blue light.

Not all investigations have been able to verify such 'overt' reactions as arm deviation, but the majority have confirmed that there is marked activation with colour. Competent experiments have shown arousal of the body and increased muscular pressure for all colours, with green causing the least increase and red the most.

In a doctoral dissertation for the University of California at Los Angeles, Robert Gerard, (1960)[24], a clinical psychologist, painstakingly reviewed the whole area of light and colour, and their physical and emotional influences. Testing of organisms entire reactions was done with very sensitive techniques. He set out to answer several questions. Do such colours as red and blue arouse different emotions? Do they stimulate body functions, brain activity and personal feelings? Do the patterns of response have anything to do with the relative energy of the coloured stimuli?

In his experiments, Gerard used red, blue and white lights transmitted upon a diffusing screen. Brightness and spectral purity were balanced. Blood pressure, palmar conductance (electrodes in the palm of the hand which indicate changes through reaction of the sweat glands), respiration rate, heart rate, muscular activation, frequency of eye blinks and brain waves were measured. Responses based on the personal experience, judgement and feeling were also recorded. On the personal side, red was found somewhat disturbing to the more anxious subjects; in fact, the higher their tension, the more they were affected by red. Blue had the reverse effect; anxious subjects were relaxed and calmed by it.

It may be concluded from his studies that:

> "Body reactions may be summarized as follows: blood pressure, for the most part, increased under the influence of red light and decreased under blue light. Both colours produced immediate increases in palmar conductance, but arousal after a period of time was consistently higher for red than for blue. "Respiratory movements increased during exposure to red light, and decreased during blue illumination." With heart rate, no appreciable differences were found between red and blue stimulation. Frequency of eye blinks increased with exposure of red light and decreased with blue light. The brain was greatly affected by introduction of all three lights, but with time (up to ten minutes), activation remained consistently greater for red than for blue. In general, palmar conductance and cortical activation are more likely to show effects of any stimulus. What is significant is that red consistently produced more pronounced effects than blue, both when first introduced and after a period of time.
>
> Blue seems to have particular merits as a relaxant and tranquilizer. The results obtained with blue light suggest trying out its use as an adjunct or supplemental form of therapy in the alleviation of various conditions. Because blue lowers blood pressure, it may have possibilities in treating high blood pressure. General relaxation and relief from tension experienced by the subjects suggest that blue may help to alleviate muscle spasms, and perhaps nervous twitches and tremors as well. Because it reduced eye blink frequency and was subjectively experienced as soothing, blue might also have some use in eye irritations. Because of its restful effects, dim blue illumination might be "conducive to sleep in cases of insomnia." It might further contribute to subjective relief of pain through its reported sedative action.

> Red and white stimulation were pretty much the same. Apparently, red and other "warm" colours are in general more related to excitation. Yet red might be useful in arousing persons with nervous depression or exhaustion. It may have value in increasing blood pressure where this action could be helpful. Whle white light may stimulate the body, it may also be boring to the mind. such boredom (with white) may prove irritating and hence be reflected in human indifference. On the other hand, red seems to excite aggression, sex, fear of injury. Bodily reactions to the two colours may be similar, but there still may be a world of difference to the subject.

The study reported by this investigator is in accord with the effects of colour, particularly red within the arousal dimension.

Evidence derived from studies related to approach-avoidance behavious (Hunt, 1960; Glanzer, 1961) hypothesize that approach avoidance is an inverted-U-shape function of arousal. In other words, physical approach, liking, preference, etc., are all maximized at a moderate level of arousal. This in turn is affected by both the environment and by internal sources.

7.5.3 Pleasantness (Pleasure)

A brief review of the relation of pleasure to colour has been made in the previous chapter. The study reported by the investigator indicates that the experience of "Pleasure" increases with red and blue, and decreases with gray.

It is hypothesized that approach behaviours of all types increase as a person experiences increased "Pleasure". An important implication of this hypothesis is that pleasure may be produced by any number of sources, including the object or person apprached. For instance one aspect of a situation (e.g., a task or another person) is enhanced by the pleasantness of other aspects of that situation. Also, approach or preference is increased by pleasant stimulations that are not contingent upon the approach behaviour. Rather, simply because of their association with a pleasant environment. Tasks, or persons within the environment have been shown to be judged as more pleasing, and consequently more approachable.

Studies by Griffitt (1970), Griffitt and Veithch (1971), Rohles (1967) and many others show that interpersonal approach-avoidance behaviour among strangers is correlated with the pleasant and unpleasant feelings of the persons with a stituation. These feelings in turn, where found to be determined by the physical qualities of the situations and were not a function of the persons present.

7.6 Informal Observation Of Overt Behaviour

To this point, the discussion has been limited to the use of rating techniques for measuring colour effects. The investigator is suggesting that various rating scale techniques may be useful for generating a better understanding of the way people think or evaluate the environment. However, in addition, an attempt was made by the investigator to gather that colour variations influence Overt Behaviour.

To explore this question, some individual patterns of Overt Behaviour were recorded informally during the rating scale studies. These observations, although incomplete, tend to support the findings already reported. For example, negative facial gestures from the subjects when they viewed the picture of the man against yellow and gray. Such comments as "I refuse to work for him", "I don't like him", "Yuk", and "very suspicious looking man", were often heard.

Against blue and red backgrounds, the comments were more flattering. Agreeable nodding, and facial gestures, "he is OK", "kind man", were some of the comments that were gathered from participants viewing the red room. The comments related to the blue room were of a mixed nature, but were more favourable than for the gray and yellow rooms.

7.7 Conslusion and Summary

This study was produced to search for evidence to substantiate that 1) the effect of colour in the environment can (or cannot) go so far as to influence the judgement of the occupant within it. 2) The usefulness of Factor Analysis in conjunction with Multivariate Analysis Of Variance as a powerful technique for evaluating information related to subjective impressions of colour.

The findings of this study provide evidence that the judgement of people is indeed affected by the background colour within an environment. In addition the above techniques are helpful in providing insight into the subjective impressions of the physical environment.

In human experience colour has a profound personal and emotional impact. This effect of stimulation along a single-stimulus dimension was reviewed in previous pages. However, most environments that are encountered are much more complex and simultaneously include stimulation in all the sense modalities[8], as well as stimulus dimensions within each modality (e.g., the many colurs in a typical setting, together with various combinations of sound, odours, temperatures, or textures). The combination of all these variations results in different overall patterns, contrasts, and level of information, which then determine responses.

Thus the perception of the environment in which human beings are a part, is a complex process and indeed to a considerable extent quite unknown to us. The study reported by the investigator is an interim report. Its findings are tentative because of the nature of the study; The limited samples of hue variables with no change of value, chroma, texture, pattern, etc. Nevertheless, the findings definitely seem to encourage further work in this direction.

However, the value of this study is not complete in re-establishing the relation between emotional dimensions and various colours. Rather it is the establishment that the colour in the environment has some effect on a person's assessment of people in the environment as well as the assessment of the environment itself.

CHAPTER EIGHT

CHAPTER VIII - Investigation Of The Effect Of Environmental Colour And Lighting On The Impression Of Room

Investigation Of The Effect Of Environmental Colour And Lighting On The Impression Of Room

8.1 Introduction

The influence of the built environment on human behaviour has received increasing attention in the general study of environmental psychology. Among the many variables relevant to this field, the visual quality of the environment, in particular, the quality of light and colour of the built environment, is of paramount interest.

There has been considerable research on visual aspects of the environment, but most of it is task-oriented, concerned with such factors as visual acuity, veiling reflection, glare ... etc. There is a growing belief that published performance standards are inadequate because they do not come to grips with the wide range of intrapsychic and social psychological effects that light and colour may have on behaviour.

It has been suggested that strict adherence to traditional lighting standards will expose building occupants to disorientation, visual clutter and a general sense of psychological depriviation[1]. It is critical to discover why such negative consequences of lighting design may occur. One answer is provided by Flynn (1972:9):

> "The fact that there seems to be little attention to the existence of such environmental influences is primarily due to lack of coordianted research that seeks a more comprehensive view of the total visual problem in building design. With only a limited concept of visual space being formally recognized in our value standards, then, we usually find that the efforts of the building design team are directed towards three major areas of emphasis in system design: (1) task or utilitarian needs, (2) hardware technology, and (3) short-term economic performance. And this limited, mechanistic concept of 'value' tends to reinforce our concern that as increasing numbers of people are required to spend lengthening periods of time in man-made interior and urban environments (as distinguished from the natural environments in which the human senses evolved), we may be approaching a condition where

insensitive design and planning are permitting environmental distortions to become the norm for many in our society.

In an effort to get beyond the mere utilitarian needs and the technological and economical stage of visual research, a number of studies were performed by Flynn and his group on the subjective effects of various lighting systems[2-3]. The primary concern of the research was with the effect of environmental lighting as a medium affecting users impression and behaviour.

As for colour, there have been a number of studies on emotional reaction to colour, such as studies of Colour-Mood Association (e.g. Crane and Levy, 1962; Lawler, and Lawler, 1965), perception of colour in interior (e.g. Richard Kuller 1968; Sivik, Lars, 1969), effect of colour and light in environment (e.g. Birren, Faber, 1969; Hering, Ewald, 1964; Gibson, N. 1967). These studies indicate that colour is a basic factor of human perception and can be used as a powerful tool to provide a more meaningful environment.

With this in mind, this investigation into the subjective effects of light and colour and their interaction in an office environment was formulated. The primary concern was with the effect of environmental colour and lighting as a medium which affects user impression and behaviour.

8.2 Theoretical Background: Light And Colour As A System Of Visual Cues.

The investigator had been investigating evidence suggesting that human responses to spatial colouring are, to some extent, shared experiences. As this research progressed the researcher came to consider the more specific possibility that some patterns of spatial light and colour might be communicative in the sense that these patterns suggest or reinforce ideas shared (to some degree) by people with a similar cultural background.

The theory underlying this possibility is that while human beings show much information through spoken and written word, other categories of information are communicated readily and subtly with visual patterns (i.e. trade marks, posters, signs, etc.). Impressions of identity and quality can be communicated through the use of somewhat abstract visual patterns. Furthermore, the visual patterns can be used to guide individual and group behaviour. Meaning can also be conveyed through recognizing the symbolism of visual form (ref. Chapter 1 and 2). Visual form can provide a sense of spatial limits such as white or yellow lines that are painted along the road.

These examples suggest that there may be a complex system of designed patterns that guide our behaviour and affect our sense of place. Each of the above examples involves the visual sense and has the capacity to communicate impressions of "meaning" that are not readily communicated with words. In other words, the experience of vision is part of an experience of recognizing and assimilating communicative patterns.[11-12-10].

This idea of spatial meaning and information content has also been explored by James Gibson[14]. He[13] suggested that "The optic array from a picture and the optic array from the (real) world can provide the same information without providing the same stimulation. Hence, an artist can capture the information about something without replicating its sensations."

He also argues for a new theory of visual perception based on the idea that light can convey information and that the brain constructs the phenomenal world from this information. Gibson suggests that this idea "depends on a new conception of light and colour in terms of an array at a point of obersvation-light considered not merely as a stimulus but also as a structure".

8.3 Measurment Of Subjective Impression To Light And Colour

The literature on information content and meaning associated with visual stimuli suggests that some psychological aspects of lighted space and coloured environment can be used to provide and enhance visual communication. This means that as a designer changes colour and lighting modes (i.e. the pattern and intensity of light and colour), he changes the information content and relative strength of visual signals and cues, and

this, in turn, alters some impressions of meaning for the users or occupants of the room.

There have been several works that have attempted to explore the lighting cue theory regardless of the effect of surface colour in environment. These studies support the notion that the users' impression of the room can vary as the lighting composition of the room changes. With this in mind, the investigator decided to direct her investigation toward surface colour (which covers an equally important part of our visual experience) and its interaction with light.

In evaluating subjective impressions of light and colour, it is important to define which characteristics of these physical stimuli are considered environmental variables, e.g., colour rendition of light, level of illumination, and hue, value or chroma dimension of surface colour.

This study explores the interaction of light pattern with hue and value of surface colour and its effect on the impression of meaning in the environment. It is hoped that this study will provide information to such questions as:

1. Does light pattern affect the subjective impression of room in a significant way?

2. Does hue affect the subjective impression of room in a significant way?

3. Does value affect the subjective impression of room in a significant way?

4. Would certain cominations of light pattern and colour affect the judgement of a room in a noticeable way?

8.4 Selection Of Physical Stimulus

As it was discussed earlier, an actual room in which the subjects could experience the different experimental variables in the related atmosphere is most desirable. This desire, however, is often hampered by the limitation of physical space and the cost and time involved in structuring such a stimulus. The next best thing, therefore, has been the selection of a three-dimensional model simulating the desired atmosphere.

A model of an office room (1"=1'-0") with moveable walls and ceiling was used in this experiment. Two types of lighting layouts, (1) diffused luminous ceiling, and (2) a combination of overhead diffused lighting and peripheral down lighting were introduced as light variables. The colour variable contained three hues, red, blue and yellow, and two values (five and eight), see figure 8.1 and 8.2. The plan of the model and its furniture arrangement was based on an actual office space visited by the investigator during the preliminary studies reported in chapter four.

8.5 Construction Of Semantic Scale

The theory of repertory grid technique and its advantage was discussed in Chapter Two. This method was employed in the construction of the semantic scale used in this study. In this way the subjects were free to employ constructs or descriptions which they rather than the investigator, considered relevant or important.

Photographs of each of the 12 room conditions were first presented to the subject. The subject was then represented with the photographs three at a time, and asked to describe a way in which two of the rooms were alike and dissimilar to the third, on the grounds of some personal characteristic, for example good, bad, confortable, etc. The subject was then presented with as many triads as were required to produce a large enough set of constructs.

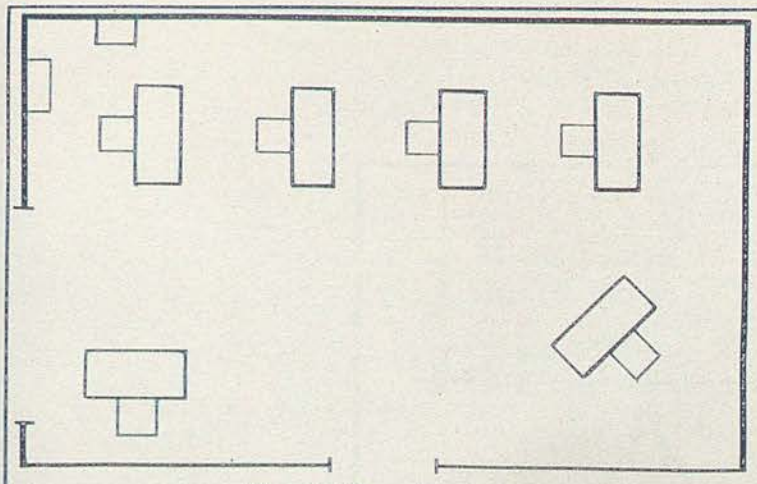
The elicited descriptions then formed a rating scale (1 to 7) used for evaluating the subjective responses to the twelve conditions, (see Appendix VI-A).

8.6 Procedure

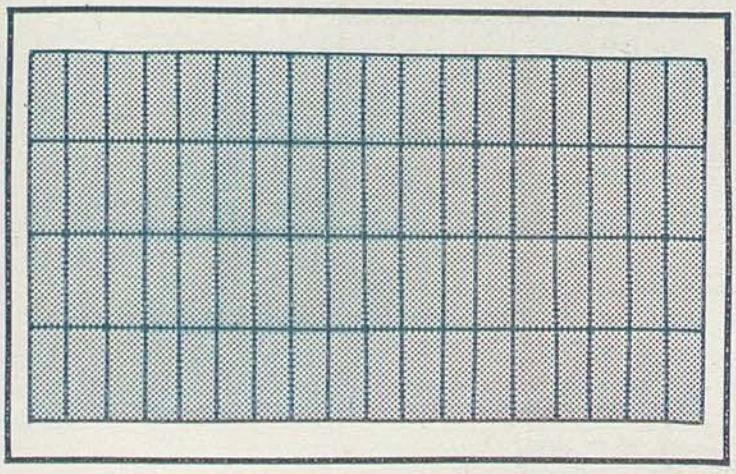
The scale model was viewed by 144 subjects. Participants were male and female, first and second year students at the Colorado Institute of Art at Denver, Colorado, U.S.A, ages 18 to 30.

Each subject viewed only one of the twelve conditions and evaluated his/her impression of the room on a series of 1 to 7 rating scales. Factor analysis was then applied to the resulting responses. The purpose of using factor analysis was to examine the interrelationships within these

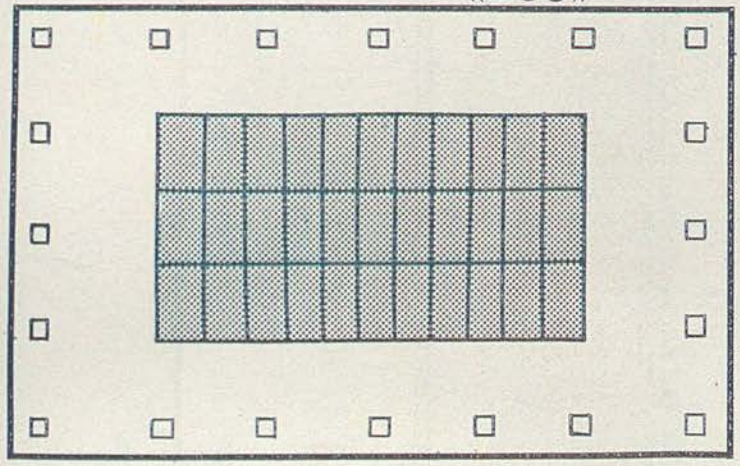
initial assessments and thus to discover the underlying dimensionality by which the individual (probably unknowingly) judged the spaces. A reliability test was run on the resulting factors to further determine how well they hung together numerically. A full factorial MANOVA was run for the dimensions generated in the factor analysis and the individual rating scales comprising the dimensions.



FLOOR PLAN



CEILING PLAN Luminous Ceiling Uniform «LCU»



CEILING PLAN
Overhead Downlight; diffused
and
Downlight Peripheral wall; direct
«OD+DP»

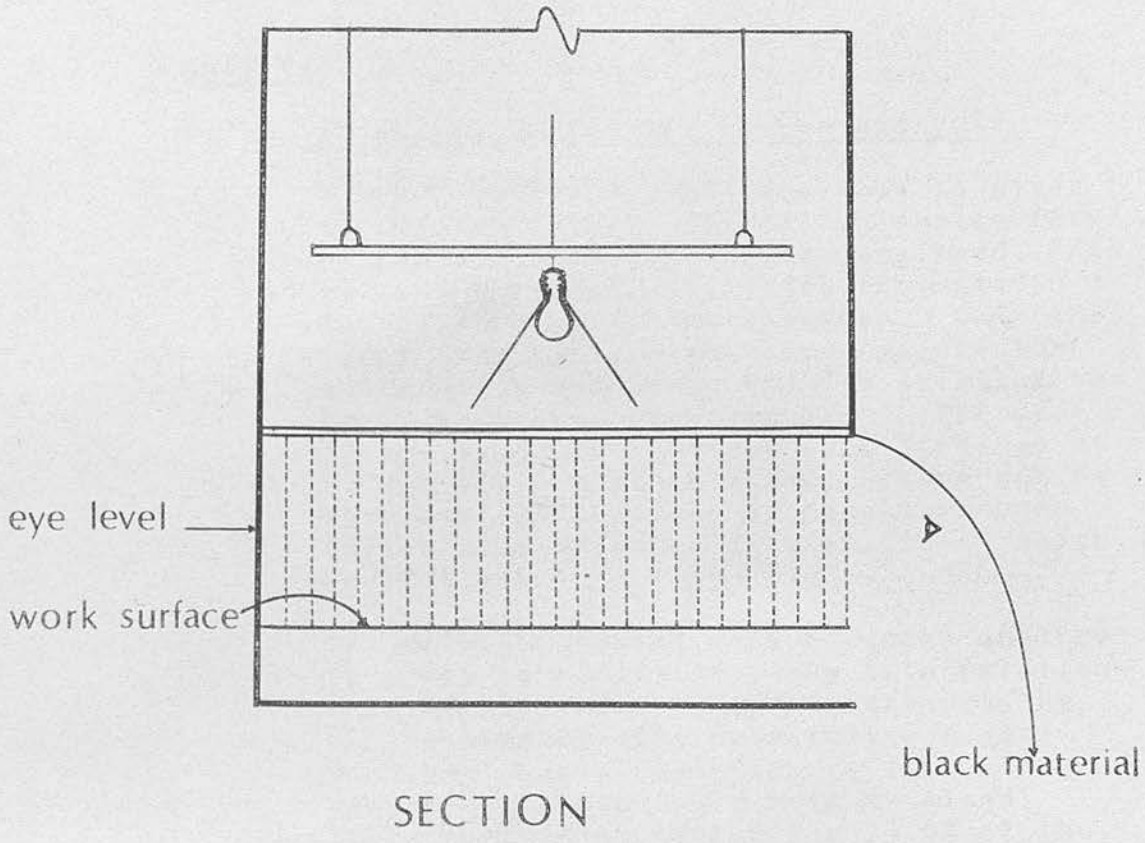
HUE : YELLOW/RED /BLUE

VALUE : 5 - 8

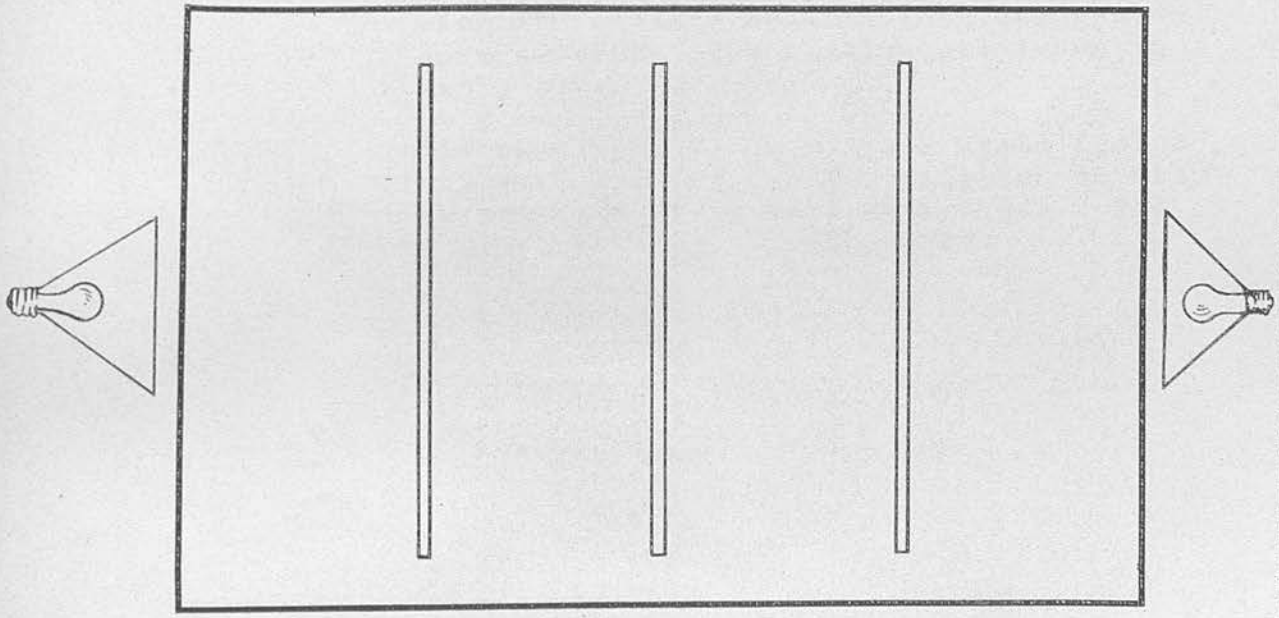
ROOM DESCRIPTION:

1 . Y8/LCU
2 . Y8/OD+DP
3 . Y5/LCU
4 . Y5/OD+DP
5 . B8/LCU
6 . B8/OD+DP
7 . B5/LCU
8 . B5/OD+DP
9 . R7/LCU
10 . R7/OD+DP
11 . R5/LCU
12 . R5/OD+DP

FIG. 8.1 DESCRIPTION OF THE ROOM; LIGHT; AND COLOUR ARRANGEMENTS.



SECTION



LIGHTING ABOVE CEILING.
3 - F40 cw and 2 - INCANDESCENT PS200W

FIG. 8.2 DESCRIPTION OF THE MODEL VIEWED BY SUBJECT.

8.7 Analysis

8.7.1 Principal Components Factor Analysis

A brief review of this analysis is given in Chapter Seven. The rating scales rated by 144 subjects were factor analyzed. Six factors were obtained which accounted for 74.8% of the total variance. Only the first four factors showed an eigenvalue above unity and accounted for 66.1% of the total variance, (see App. VI-B, Factor Analysis, P. 2). Scales with loadings of .5 and above were selected. Those scales with similar loadings on more than one factor were rejected as statistical noise, see Table 8.1.

The selected scales were refactor analyzed in order to verify that the interrelationship of the factors was not affected by the removal of the inconclusive scales (noise). Again four factors with eigenvalue above unity were obtained. These factors accounted for 73.0% of the total variance (see App. VI-C, Factor Analysis, P. 2). Again, those items with similar loadings on more than one factor were deleted. The results are shown in Table 8.2.

The resulting Table 8.2 was again factor analyzed for further verification of the interrelationship between factors. The four factors again reappeared.

	Factors		Eigenvalue	Pct of Var	Cum Pct.
I	Radiant/	.75386	9.24034	44.0	44.0
	Exciting/	.73070			
	Stimulating/	.70292			
	Like/	.65293			
	Interesting/	.64036			
	Beautiful/	.61888			
	Pleasant/	.60345			
	Visually Warm/	.57023			
II	Spacious/	.75247	1.93110	9.2	53.2
	Clear/	.70804			
	Free/	.64176			
	Friendly/	.63933			
III	Functional/	.78869	1.44184	6.9	60.1
IV	Bright/	.84282	1.27106	6.1	66.1
	Visual Distinct/	.65654			
V	Formal/	.94235	.96624	4.6	70.7
VI	Unusual/	.92222	.86646	4.1	74.8

Table 8.1 - Factors With Factor Loading of .5 And Above

	Factors	Eigenvalue	Pct of Var	Cum Pct
I	Like/ .85552	5.97904	46.0	46.0
	Exciting/ .74597			
	Beautiful/ .73420			
	Pleasant/ .70767			
	Radiant/ .69902			
	Visually Warm/ .69426			
II	Spacious/ .82276	1.35776	10.4	56.4
	Clear/ .77844			
	Friendly/ .63131			
	Free/ .60924			
III	Bright/ .89132	1.10545	8.5	64.9
IV	Formal/ .93806	1.04157	8.0	73.0

Table 8.2 - Four Factors With Loadings Above .6

The first three factors showed an eigenvalue above unity, and accounted for 65.4% of the total variance. The following table presents the result of this analysis. See App. VI-D, Factor Analysis, P. 2.

Factors		Eigenvalue	Pct of Var	Cum Pct
I (A)	Like/ .82525	4.87172	44.3	44.3
	Exciting/ .75485			
	Beautiful/ .74157			
	Radiant/ .71883			
	Visually Warm / .71874			
	Pleasant/ .71764			
II (B)	Spacious/ .83270	1.22008	11.1	55.4
	Clear / .73932			
	Free / .61210			
III (C)	Formal / .95832	1.10386	10.0	65.4
IV (D)	Brightness/ .90696	.92966	8.5	73.9

Table 8.3 - Four Factors, Rating Scales With Loadings Above .6. Only The First Three Factors Have Eigenvalue Unity.

Observation from these analysis indicate that the items in Factor I illustrate emotional dimensions characterizing "pleasure" and "arousal", whereas items in Factor II are more related to "spatial control" or "dominance". Factors III and IV consist of one item each dealing with bright/dim and formal/informal qualities of space.

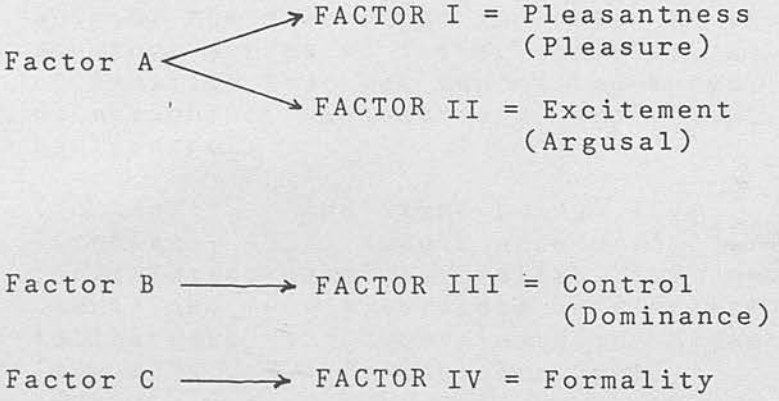
The investigator initially was seeking more evidence about the "pleasure", "dominace" and "arousal" dimensions. It was noticed that two of the emotional dimensions (pleasure and arousal) appeared in Factor I combined as one group. In addition, one of the variables (friendly) on Factor II (Table 8.2) seems to belong to the dimension of "pleasure". It was thought that due to the limitations of the mathematical model to differentiate clusters under certain conditions the computer program had combined the dimensions of "pleasure" and "arousal".

To examine this possibility, two scales were added to Factor I. These were 'Friendly', which the investigator believed to be more related to Factor I, and 'Functional' which had previously loaded heavily on this factor but had been deleted because of concurrent heavy loading on another factor. It was believed that if Factor I was a combination of two emotional dimensions ("pleasure" and "arousal") separate factors should appear to account for these dimensions. Based on previous experience with variables comprising Factor I, a refactoring of these variables should produce two factors, one composed of variables friendly, pleasant, beautiful and like, and the other composed radiant, exciting and visually warm. Where functional was expected to load was unknown. If this hypothesis proved to be wrong it would indicate that the items of these dimensions have very high possitive correlations and express emotions along a single dimension. Three factors were produced with this analysis, which accounted for 77.4% of the total variance. Only the first factor had an eigenvalue above unity and accounted for 57.1% of the total variance (see App. VI-E, Factor Analysis, P. 2). This factor is clearly dealing with "pleasantness" of the space. Factor II, with eigenvalue of .89 accounted for 11.1% of the total variance and is related to "excitement" of the space, and finally the third factor deals with "functionality" of the space. This item (V.15) appeared on other factors in the first and second stage of the analysis (App. VI-B, VII-C) with no strong or unequivocal relation.

	Factors		Eigenvalue	Pct of Var	Cum Pct
I	Friendly/	.86688	4.56982	57.1	57.1
	Pleasant/	.84602			
	Beautiful/	.80897			
	Like/	.68779			
II	Visually Warm/	.80459	.89006	11.1	68.2
	Exiciting/	.70885			
	Radiant/	.68944			
III	Functional/	.95397	.73572	9.2	77.4

Table 8.4 - Three Factors Elicited From The Initial First Factor (Table-8.2).

The following diagram summarizes the final result based on Tables 8.3 and 8.4.



FACTOR I deals with a general evaluative impression, 'pleasantness', as shown by the character of rating scales loading on this factor. In Table 8.10 to 8.13 the mean ratins of the twelve colour and lighting arrangements are presented. As can be seen arrangements 12 and 9 were generally preferred, and arrangements 8 and 10 were least favoured.

FACTOR II appeared to represent an impression of spatial excitement and radiance and is named 'excitement'. As shown by the mean rating of the twelve arrangements on Table 8.10 to 8.13, arrangements 12 and 9 were generally preferred and 8 and 6, the least favoured on this factor.

FACTOR III was an impression of spatial freedom as shown by the character of the rating scale loaded on this factor and is tentatively named 'control'. The mean ratings of the twelve arrangements are shown for this factor in Table 8.10 to 8.13. As can be seen, arrangement 7 was generally preferred and arrangement 8 was the least favoured on this factor.

FACTOR IV consists of one item and is related to the formality of the space. As shown in Table 8.5 to 8.13 arrangement 2, 12, 1 and 11 are preferred for this factor, whereas 6 and 7 are the least favoured.

8.7.2 Realiability

To further examine the numerical relationship of the dimensions generated in the previous series of factor analysis, a reliability test was run on the three dimensions of pleasantness, excitement, and control.

Cronbach's And Standardized Item (Cronbach, 1951) models were used.[15] The 'correlation matrix', 'reliability coefficient' and, 'if variable were deleted', tables were used to evaluate the dimensions, (see APP. V-F., Reliability Test).

All the scales within each dimension had correlation matrix values above .35. Dimension one (pleasantness) was particularly strong with all values above .6, (see APP. VI-F, Reliability Test, P. 2). The reliability coefficient for pleasantness, excitement and control were .905, .740, and .719 respectively. On the " if variable were deleted" tables the dimensions' means variances and coefficients deteriorated with the exclussion of variables in all cases but one. In dimension three the exclussion of the variable free (V.9) increased the coefficient from .79 to .740, (see APP. VI-F, P. 6).

8.7.3 MANOVA

As the experimental design involved multiple dependent variables the SPSS Multivariate analysis of variance (MANOVA) was used. Of particular interest were the univariable and multivariate linear estimations of the null hypothesis.

A full factorial model was run on hue, value, light and sex (independent variables). This was run for the individual dependent variables comprising Factors I through IV, (pleasantness, excitement, control and formality). The independent variables (hue, value, light pattern) were also run with dependent variables equivalent to Factor I through IV (labeled scales I through IV).

8.7.3.1 Sex Effect

The interaction effect of sex with the other independent variables, both singularly and combined (i.e. sex x hue, and sex x hue x light), was at no time significant at the .05 level for the multivariate test of significance. The closest it came was .063 for 'hue x light x sex'. In the univariate F-test there was great variation in the significance along the individual dependent variables, ranging from .006 to .972. the main effect of sex was .918 for the multivariate test of significance. The main effect of sex was not significant at the .05 level for any of the variables in the univariate F-test, (see App. VI-G, P. 14, MANOVA Analysis). The summary of this stage of analysis is shown in the following table.

	Multivariate interaction Effects		
SEX BY	Hue .165	Value .236	Light .664
	H x V .279	H x L .064	V x L .179
	H x V x L .104		
Main Effect: Sex = .918			

Table 8.5 - Sig. Of F For Sex (Interaction Effects And Main Effect)

8.7.3.2 Hue, Value And Light Effects

Condition A - In the multivariate test of significance Hue and Light were very significant at the greater than 1×10^{-8} level and 4.59×10^{-5} level respectively. Value was also significant but only at the .039 level. The univariate F-Tests showed light and hue significant on 75% of the dependent variables. Value was significant on less than 20% of the dependent variables. The variables not significant for value ranged from .174 to .935.

Of considerable interest are the interacting effects between Hue, Value and Light as they make interpretation of the main effects of Hue, Value, and Light difficult to analyse. In the three possible two-way interactions H x V, H x L, V x L and the three-way interaction, the interaction effects were significant in the Multivariate Tests at a minimum of the .001 level. For the most part the correspondence univariate F-Tests follows the same pattern (see App. VI-G). The summary of this analysis is presented in Table 8.6A, B and C.

Multivariat Interaction Effects		
H U E B Y	Value 4.35×10^{-4}	Light $.718 \times 10^{-7}$
	V x L 1.78×10^{-4}	
Main Effect Of Hue:	$> 1 \times 10^{-8}$	

Table 8.6A - Sig. Of F For Hue (Interaction Effect And Main Effect)

Multivariat Interaction Effects		
VALUE BY	Hue 4.35×10^{-4}	Light .001
	H x L 1.78×10^{-4}	
Main Effect of Value: .039		

Table 8.6B - Significant of F For Value (Interaction Effects and Main Effect)

Multivariat Interaction Effects		
LIGHT BY	Hue $.718 \times 10^{-7}$	Value .001
	H x V 1.78×10^{-4}	
Main Effect of Light: 4.59×10^{-5}		

Table 8.6C - Significant of F For Light (Interaction Effects and Main Effect)

Condition B - When the MANOVA was run using the factors "Pleasantness", "Excitement', "Control" and "Formality" (Scales One to Four) as dependent variables, substantially the same patterns emerged as in condition A. The main effect of Sex was not significant at the .05 level and its inclusion with other independent variables was not interactive at the .05 level of significance. The main effects of Hue and Light were very significant for Factors I and III while the main effect of Value was very weak for Factors I through III. As with condition A, the interaction effects of all three independent variables were sufficient to make interpretation of the main effects difficult, (App. VI-H).

8.7.3.3 General Trends In Data

Hue, value and light were highly interactive and it was felt that simple tests of significance would not easily lead to an understanding of the data. Therefore, the mean tables were drawn in order to search for consistent patterns running through the data (see App. VI-I).

For the sake of clarity, the data will be discussed for Factor I, Factor II and Factor III separately. Within each factor hue, value and light were respectively held constant in order to examine the relationship of the other two independent variables. (See Tables 8.7, 8.8, and 8.9).

Hue_1 (Yellow): A highly interactive effect between Light and Value was observed. This is illustrated by L_1V_1 and L_2V_2 having similar means and being preferred to L_1V_2 and L_2V_1, (L_1V_2 and L_2V_1 also have similar means).

Hue_2 (Blue): L_1 was consistently preferred to L_2 for V_1 and V_2. A moderate interaction has been observed for Light and Value. This is illustrated by L_1V_1 having a smaller mean than expected.

Hue_3 (Red): A change in response for Value was more pronounced for L_2 than L_1. This was primarily seen when L_2V_1 and L_2V_2 were compared. L_2V_2 was strongly preferred over L_2V_1.

V_1 (Value 8): A change in Hue did not produce as large a change in response as the change of Light did. Also, changes for L_1 to L_2 consistently increased the mean point. The interaction of Hue and Light is illustrated by a greater change in response to Hue for L_2 than for L_1.

V_2 (Value 5): A strong interaction betwen Hue and Light was in evidence. For H_1 and H_3 a change from L_1 to L_2 decreased the mean, while for H_2 the same change increased the mean.

L_1 (Luminous Ceiling, Uniform): A general interactive effect was found between Value and Hue. However, the pattern of response varied for each rating scale making a formulation of general trends difficult.

L_2 (Overhead diffused and Prepheral Wall): H_1 and H_3 were more positive with V_1 than V_2, whereas H_2 was more positive with V_2 than V_1. No change in the response to Hue was found for V_1.

The following tables were used in the above analysis. The tables were drawn from mean tables shown in APP. VI, I.

HUE

Hue_1 = Yellow; Hue_2 = Blue; Hue_3 = Red

Friendly

	V_1	V_2
L_1	2.6	3.4
L_2	3.6	2.5

(H_1)

	V_1	V_2
L_1	2.4	2.2
L_2	3.5	4.8

(H_2)

	V_1	V_2
L_1	1.8	2.6
L_2	4	1.8

(H_3)

Pleasant

	V_1	V_2
L_1	2.7	4.2
L_2	4.0	2.7

(H_1)

	V_1	V_2
L_1	2.6	3.3
L_2	4.3	5.4

(H_2)

	V_1	V_2
L_1	2.3	2.4
L_2	4.2	1.9

(H_3)

Beautiful

	V_1	V_2
L_1	3.5	3.8
L_2	4.1	2.9

(H_1)

	V_1	V_2
L_1	2.8	3.2
L_2	4	5.3

(H_2)

	V_1	V_2
L_1	2.4	2.6
L_2	4.4	2.0

(H_3)

Like

	V_1	V_2
L_1	3.2	3.4
L_2	4.8	2.3

	V_1	V_2
L_1	3.2	4.3
L_2	4.7	5.3

	V_1	V_2
L_1	2.3	2.4
L_2	4.7	2.3

Table 8.7A - General Trends Within Hue For Factor I

Value

V_1 = Value 8; V_2 = Value 5

Friendly

	H_1	H_2	H_3
L_1	2.6	2.4	1.8
L_2	3.6	3.5	4

(V_1)

	H_1	H_2	H_3
L_1	3.4	2.2	2.6
L_2	2.5	4.8	1.8

(V_2)

Pleasant

	H_1	H_2	H_3
L_1	2.7	2.6	2.3
L_2	4.0	4.3	4.0

(V_1)

	H_1	H_2	H_3
L_1	4.2	3.3	2.4
L_2	2.7	5.4	1.9

(V_2)

Beautiful

	H_1	H_2	H_3
L_1	3.5	2.8	2.4
L_2	4.1	4	4.4

(V_1)

	H_1	H_2	H_3
L_1	3.8	3.2	2.6
L_2	2.9	5.3	2.0

(V_2)

Like

	H_1	H_2	H_3
L_1	3.2	3.2	2.3
L_2	4.8	4.7	4.7

(V_1)

	H_1	H_2	H_3
L_1	3.4	4.3	2.4
L_2	2.5	5.3	2.3

(V_2)

Table 8.7B - General Trends Within Value For Factor I

Light

L_1 = Luminous Ceiling Uniform L_2 = Overhead Diffused And Peripheral Wall, Direct

Friendly

	H_1	H_2	H_3
V_1	2.6	2.4	1.8
V_2	3.4	2.2	2.6

(L_1)

	H_1	H_2	H_3
V_2	3.6	3.5	4
V_2	2.5	4.8	1.8

(L_2)

Plesant

	H_1	H_2	H_3
V_1	2.7	2.6	2.3
V_2	4.2	3.3	2.4

(L_1)

	H_1	H_2	H_3
V_1	4.0	4.3	4.0
V_2	2.7	5.4	1.9

(L_2)

Beautiful

	H_1	H_2	H_3
V_1	3.5	2.8	2.4
V_2	3.8	3.2	2.6

(L_1)

	H_1	H_2	H_3
V_1	4.1	4	4.4
V_2	2.9	5.3	2.0

(L_2)

Like

	H_1	H_2	H_3
V_1	3.2	3.2	2.3
V	3.4	4.3	2.4

(L_1)

	H_1	H_2	H_3
V_1	4.8	4.7	4.7
V	2.5	5.3	2.3

(L_2)

Table 8.7C - General Trends Within Value For Factor I

Factor II:

Hue_1 (Yellow): Light and Value were quite interactive. The mean responses for L_1V_1 and L_2V_2 were approximately equal. The average response for L_1V_2 and L_2V_1 were also approximately equal, but their means were greater than L_1V_1 and L_2V_2.

Hue_2 (Blue): The mean response to V_1 was generally smaller than to V_2, for both lighting conditions. In addition, in general the mean response to L_1 was slightly lower than L_2 for both Values. It is interesting to note that Light and Value were not particularly interactive for this Hue.

Hue_3 (Red): V_2 had a smaller mean response than V_1 for both lighting conditions. Also, the mean response to L_1 was smaller than to L_2 for both Values. L_2V_1 has a much larger mean response than do the other combinations of Light and Value.

V_1 (Value 8): In general L_1 had a smaller mean than L_2 for all Hues. However, this trend was better defined for H_1 and H_3.

V_2 (Value 5): There is a strong interaction between H_1 and H_3 and the two lighting conditions. L_1H_1 had a much larger mean than expected. The mean responses for H_2 were in general the largest, while H_3 had the smallest.

L_1, (Luminous Ceiling,Uniform): A similar situation as explained for V_2 can be observed. It is interesting to note that $H_1 H_2$ produced a much larger mean response when compared with various combinations of H_1 H_2 H_3 and V_1 V_2. The response to H_1^2 H_2^3 was almost as large as response gathered for H_2.

L_2, (Overhead Diffused, and Peripheral Wall): V_2 had a much smaller mean than V_1 for H_1 and H_3, whereas, V_1 had a smaller mean than V_2 for H_2. Mean responses for H_2 were generally greater than for other combinations of Hue and Value.

HUE

Hue_1 = Yellow; Hue_2 = Blue; Hue_3 = Red

Visually Warm

	V_1	V_2
L_1	2.3	3.7
L_2	3.4	2.2

(H_1)

	V_1	V_2
L_1	4.0	5.2
L_2	2.8	4.3

(H_2)

	V_1	V_2
L_1	2.1	1.9
L_2	3.7	1.9

(H_3)

Exciting

	V_1	V_2
L_1	2.8	4.4
L_2	4.3	3.3

(H_1)

	V_1	V_2
L_1	4.3	4.7
L_2	4.7	5.2

(H_2)

	V_1	V_2
L_1	2.2	1.7
L_2	4.3	1.8

(H_3)

Radiant

	V_1	V_2
L_1	2.7	4.8
L_2	3.5	2.7

(H_1)

	V_1	V_2
L_1	3.4	3.6
L_2	4.3	4.7

(H_2)

	V_1	V_2
L_1	2	1.6
L_2	2.9	2.3

(H_3)

Table 8.8A - General Trends Within Hue For Factor II

Value

V_1 = Value 8; V_2 = Value 5

Visually Warm

	H_1	H_2	H_3
L_1	2.3	4.0	2.1
L_2	3.4	2.8	3.7

(V_1)

	H_1	H_2	H_3
L_1	3.7	5.2	1.9
L_2	2.2	4.3	1.9

(V_2)

Exciting

	H_1	H_2	H_3
L_1	2.8	4.3	2.2
L_2	4.3	4.7	4.3

(V_1)

	H_1	H_2	H_3
L_1	4.4	4.7	1.7
L_2	3.3	5.2	1.8

(V_2)

Radiant

	H_1	H_2	H_3
L_1	2.7	3.4	2
L_2	3.5	4.3	2.9

(V_1)

	H_1	H_2	H_3
L_1	4.8	3.6	1.6
L_2	2.7	4.7	2.3

(V_2)

Table 8.8B - General Trends Within Value For Factor II

Light

L_1 = Luminous Ceiling Uniform; L_2 = Overhead - Downlight, and Periferal Wall

Visually Warm

	H_1	H_2	H_3
V_1	2.3	4.0	2.1
V_2	3.7	5.2	1.9

(L_1)

	H_1	H_2	H_3
V_1	3.4	2.8	3.7
V_2	2.2	4.3	1.9

(L_2)

Exciting

	H_1	H_2	H_3
V_1	2.8	4.3	2.2
V_2	4.3	4.7	1.7

(L_1)

	H_1	H_2	H_3
V_1	4.3	4.7	4.3
V_2	3.3	5.2	1.8

(L_2)

Radiant

	H_1	H_2	H_3
V_1	2.7	3.4	2
V_2	4.8	3.6	1.6

(L_1)

	H_1	H_2	H_3
V_1	3.5	4.3	2.9
V_2	2.7	4.7	2.3

(L_2)

Table 8.8C - General Trends Within Light For Factor II

Factor III

Hue_1 (Yellow): No clear interaction effect was observed between Light and Value for this Hue. No clear pattern of responses can be observed based on Table 8.9A.

Hue_2 (Blue): A change in lighting conditions produced a strong and consistent change of response. Mean responses for L_1 were generally lower than L_2. In addition, a change of Value for L_2 caused a greater difference in response than it did for L_1.

Hue_3 (Red): Light and colour are quite interactive. The mean response for L_1V_1 and L_2V_2 were consistently more positive than L_1V_2 and L_2V_1.

V_1 (Value 8): Interaction was observed with Hue and Light. Responses to H_1 and H_3 changed in the same direction as H_2 when light condition varied. However, the magnitude of change was much greater for H_2 than for H_1 and H_3.

V_2 (Value 5): For H_1 and H_3, L_2 had a smaller mean than L_1, while for H_2 L_1 had a smaller mean than L_2. Not only did the response to H_2 change in an opposite direction to H_1 and H_3 with a change in lighting conditions, but the magnitude of change for H_2 was also greater.

L_1 (L.C.U.): The mean responses for H_2 (for both values) were smaller than for H_1 and H_3. The mean responses to V_1 (for H_1 and H_2) were smaller than for V_2. Whereas H_2, V_2 had a slightly smaller mean than V_1.

L_2 (O.D. & P): For both values H_2 had a much greater mean responses than H_1 or H_3. In general, the response to a change in Value varied for all three hues. H_1 showed little consistent change; for H_2 the mean for V_1 was much smaller than for V_2; and, finally for H_3 the mean for V_2 was much smaller than for V_1 with H_3 V_2 tending to be the smallest mean for L_2.

HUE

Hue_1 = Yellow, H_2 = Blue, Hue_3 = Red

Spacious

	V_1	V_2
L_1	1.8	2.6
L_2	2.3	2.1

(H_1)

	V_1	V_2
L_1	2.3	2.2
L_2	3.7	5.3

(H_2)

	V_1	V_2
L_1	2.5	2.7
L_2	4.3	2.5

(H_3)

Clear

	V_1	V_2
L_1	1.9	2.0
L_2	2.3	2.5

(H_1)

	V_1	V_2
L_1	1.7	1.7
L_2	4.4	6.2

(H_2)

	V_1	V_2
L_1	2.2	2.5
L_2	2.8	1.6

(H_3)

Free

	V_1	V_2
L_1	4.4	5.1
L_2	4.0	4.4

(H_1)

	V_1	V_2
L_1	3.9	3.1
L_2	5.3	6.2

(H_2)

	V_1	V_2
L_1	3.6	4.6
L_2	4.5	3.7

(H_3)

Table 8.9A - General Trends Within Hue For Factor III

Value

V_1 = Value 8; V_2 = Value 5

Spacious

	H_1	H_2	H_3
L_1	1.8	2.3	2.5
L_2	2.3	3.7	5.3

(V_1)

	H_1	H_2	H_3
L_1	2.6	2.2	2.7
L_2	2.1	5.3	2.5

(V_2)

Clear

	H_1	H_2	H_3
L_1	1.9	1.7	2.2
L_2	2.3	4.4	2.8

(V_1)

	H_1	H_2	H_3
L_1	2.0	1.7	2.5
L_2	2.5	6.2	1.6

(V_2)

Free

	H_1	H_2	H_3
L_1	4.4	3.9	3.6
L_2	4.0	5.3	4.5

(V_1)

	H_1	H_2	H_3
L_1	5.1	3.1	4.8
L_2	4.4	6.2	3.7

(V_2)

Table 8.9B - General Trends Within Value For Factor III

Light

L_1 = L. C. U. L_2 = O. D. P.

Spacious

	H_1	H_2	H_3
V_1	1.8	2.3	2.5
V_2	2.6	2.2	2.7

(L_1)

	H_1	H_2	H_3
V_1	2.3	3.7	4.3
V_2	2.1	5.3	2.5

(L_2)

Clear

	H_1	H_2	H_3
V_1	1.9	1.7	2.2
V_2	2.0	1.7	2.5

(L_1')

	H_1	H_2	H_3
V_1	2.3	4.4	2.8
V_2	2.5	6.2	1.6

(L_2)

Free

	H_1	H_2	H_3
V_1	4.4	3.9	3.6
V_2	5.1	3.1	4.8

(L_1)

	H_1	H_2	H_3
V_1	4.0	5.3	4.5
V_2	4.4	6.2	3.7

(L_2)

Table 8.9C - General Trends Within Light For Factor III

8.8 Discussion

These tests suggest that lighting variables do induce some consistent and, apparently, shared impressions for the users, as do also the hue and value of the surface colour.

This study provides evidence that hue, value and light are highly interactive, and thus it is impossible to draw simple design decisions about light or colour as two separate and individual factors affecting the impression of a room.

Furthermore, the study provides more evidence for the notion that there are basic responses that are elicited by physical stimuli and they can be characterized in terms of three emotional dimensions: "Pleasantness", "Excitement" and "Control". Therefore, the different responses were analyzed along these dimensions.

An interesting descovery resulting from this study was that various combinations of value, hue and light can result in similar emotional impressions. For example, a room with uniform lighting (L_1) and blue walls of value five considered as spacious as the same room with diffuse downlight and peripheral wall lighting (L_2) and red walls of value five.

This indicates that we percieve the environment as a whole, and a simple classification of the individual physical stimuli and the endless listing of their emotional impact on our visual environment simply cannot be relied upon. In some of the previous studies related to the emotional impression of light on subjective impressions of the users, a non-uniform lighting was preferred over uniform lighting. This study shows that both lighting conditions can be liked or disliked equally depending upon the surface colour with which they are paired. How do we know which combination will have a fruitful or disappointing result? The answer relies on future research. It is evident that endless studies on lighting or colour as two individual physical stimuli do not provide us with the type of data we need in order to make decisions in real situations, as we cannot separate colour in the environment from the lighting under which we percieve it.

Although this study must only serve as a beginning for future studies, in this line of research, some tentative conclusions concerning the subjective implications of some lighting and colour design decisions can be made. The discussion related to Factor IV is missing from the following as this factor consists of only one item.

Factor I - Pleasantness

Light and colour conditions '12' and '9' were judged the most pleasant and 8 and 10 the least. (See Table 8.10, 8.11, 8.12 and 8.13).

Condition "12" is a combination of red walls of lower value and non-uniform lighting (L_2), whereas condition "9" consisted of red walls of high value and uniform light (L_1). Room "8" had non-uniform lighting (L_2) with blue walls of low value, and room "10" consisted of non-uniform light and red walls of high value.

Uniform lighting (L_1) was preferred with red walls of value eight, whereas a strong negative response was made when lighting conditions changed to non-uniform lighting (L_2). Producing similar differences in response, conditions 12 and 8 were of identical value and lighting condition, but varied in hue. As can be seen from the graphs, the responses gathered for these two rooms are quite different.

Factor II - Excitement

Conditions 12, 9 and 11 consisting of various shades of red, were more positive along this dimension, and conditions 6, 7 and 8, consisting of various shades of blue, were the least possitive. At the same time blue of value eight and lighting condition two (arrangement-5) was more positive than red of value eight with similar lighting (arrangment-10).

This again suggest that it is the interaction of light and colour which enhances or reduces the 'excitement' of the space.

Factor III - Control

A discussion of this factor is very difficult due to the complexity of the responses. In general, again it seems the right combination of light and colour can make the space look spacious, clear, or free. Notice that here again room condition (8) received very negative responses.

Overall, the graphs presenting the mean responses for each dimension and the analysis reported in preceding pages suggest that:

a) Red was preferred over blue (with few exceptions), and yellow tended to be the second favourite hue.

b) For red and yellow a combination of low value (5) with non-uniform lighting (L_2) was preferred, whereas a high value (8) was favoured when combined with uniform lighting (L_1). This could be due to the visual contrast that light made on the walls with low value (5) which added more interest. This contrast effect was not strong on walls with high value (8) and hence, it was not preferred. (See figure 'A' and 'B' below).

However, in the case of blue, this effect was reversed. The dark blue (V.5) was not favoured when combined with non-uniform lighting (L_2).

c) There is no clear indication that one type of lighting is preferred over the other. It is the combination of light with hue and value of the surface colour that makes one type of lighting more desirable than others.

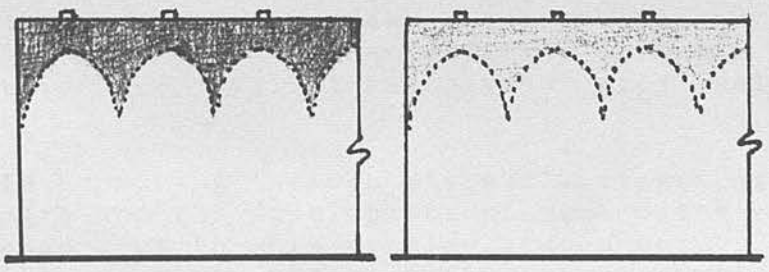


Figure A,V.5

Figure B,V.8

8.9 Conclusion

It is well known that lighting affects both the performance of tasks, and the user's impression of the room. Similarly it is widely accepted that colour affects the mood, and hence the subjective impression, of a space. Most of the previous studies have been concerned with one physical stimulus. The study reported here suggests that there is an ongoing interaction effect between physical stimuli in the environment, and thus a study of an isolated physical stimulus divorced from other stimuli such as surface colour, texture, space planning ... etc. cannot be expected to produce a result which would arm the designer for his decision making.

At this point, this work seems to support the theory that the experience of lighted and coloured space is, to some extent, a measurable experience. Furthermore, the findings tend to substain the idea that light and colour in the interior can be discussed as a vehicle that alters the information content of the visual field, and we may now be able to document how this intervention affects impressions and sensations of well-being.

More specifically, these studies tend to reinforce the need for engineers and designers to be sensitive to ideas of lighting function that are broader than simple task oriented quantitative standards designed to permit reading, typing, draughting, and similar visual tasks.

While some research groups are already active in this field, the investigator hopes that other researchers will also join in this overall study, (1) so we may cooperate in developing a bank of data on the effects of light and colour on subjective environmental quality; and (2) so we may cooperate in developing deeper insights into the problems, and hence the manipulation of the environment for our physical and psychological well being.

We appear to be moving through the early stages of gathering data and the development of methodologies that will enable us to more precisely document these qualities. Without downgrading the importance of prior research (much of it being quite valuable) a more wholistic approach to the study of the interactive effects of physical stimulis, as opposed to individual effects, is necessary before we even begin to scratch the surface of how the environment

really affects us and how we can use our ability as intelligent human beings to manipulate it to our best advantage.

8.10 Summary

This study was orginally formulated to investigate the effect of light (only the light pattern was studied here) and wall colour (only the dimensions of hue and value were used, while chroma stayed constant) on the subjective impression of a room.

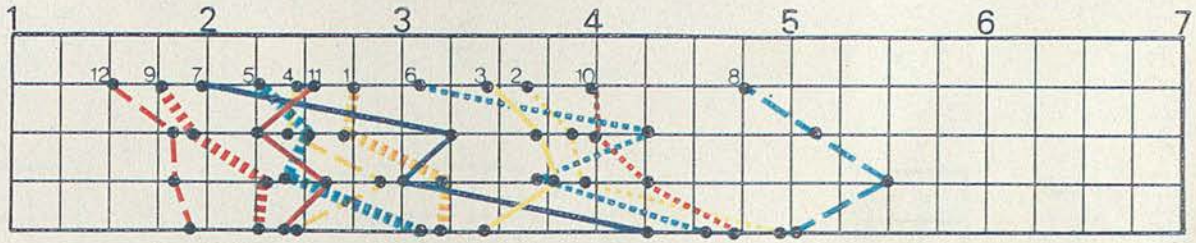
Factor Analysis, reliability and MANOVA (multivariate and univariate analysis) were used for the analysis of the data. Three emotional responses, 'pleasantness', 'excitement' and 'control', were found and used as the frame work to discuss the subjects responses.

It was found that the effect of colour and light is highly interactive, and therefore an isolated study of light or colour cannot by itself be fruitful. For example, it was not possible for the investigator to determine one lighting condition to be better or worse than the other. It was only considered negative or positive when it was combined with certain hues or values of the room's surfaces (walls).

However, the findings are tentative in the sense that they present limited samples of lighting or colour variables. Nevertheless, the findings definitely encourage further work in this direction. They seem to MANOVA the theory that the experience of the interaction of lighted and coloured space is, to some extent, a shared experience with similar quantifiable impressions. Finally, the findings support the idea that the interaction of light and colour can be discussed as a vehicle that alters the information content of the visual field, and that this interaction has some effect on human-behaviour and on our sensation of well-being.

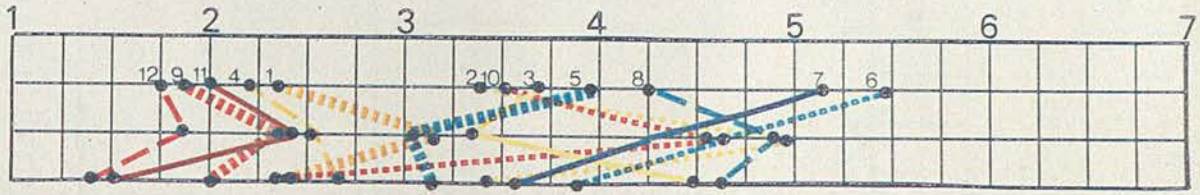
FACTOR I

FRIENDLY
PLEASANT
BEAUTIFUL
LIKE



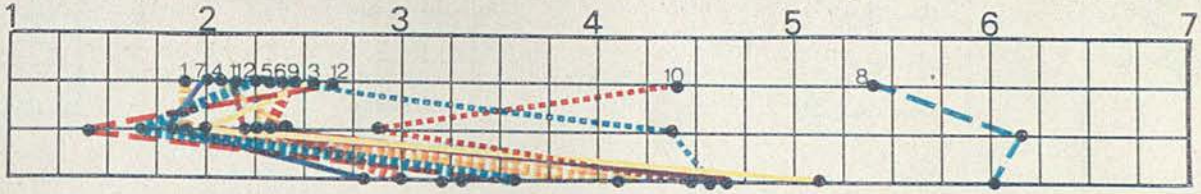
FACTOR II

VISUALLY WARM
EXCITING
RADIANT



FACTOR III

SPACIOUS
CLEAR
FREE



FACTOR IV

FORMAL

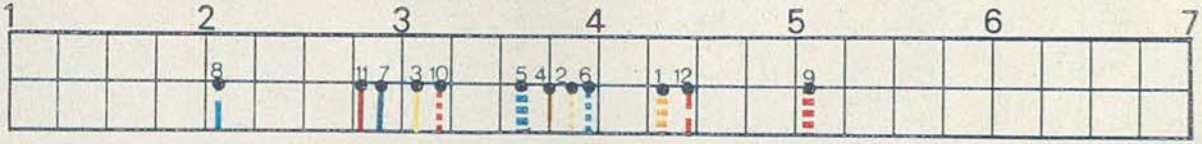
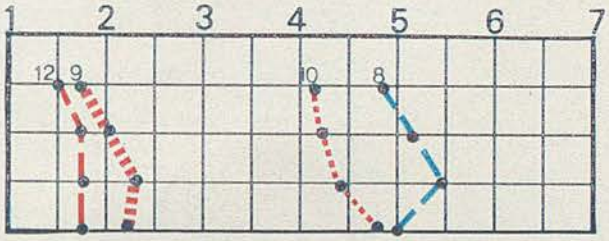


TABLE 8.10 PRESENTS THE MEAN RATING OF EACH OF THE 12 ARRANGME

FACTOR I

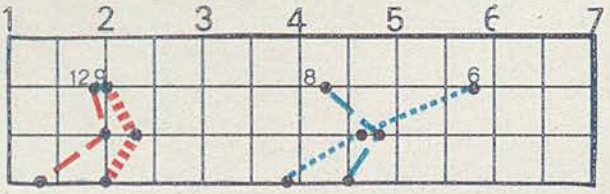
FRIENDLY
PLEASENT
BEAUTIFUL
LIKE



HOSTLE
UNPLEASENT
UGLY
DISLIKE

FACTOR II

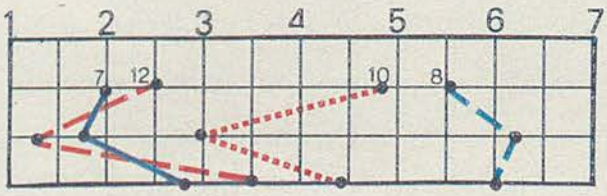
VISUALLY WARM
EXCITING
RADIANT



VISUALLY COLD
BORING
DULL

FACTOR III

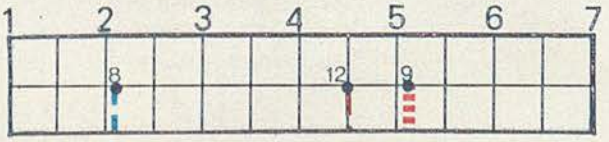
SPACIOUS
CLEAR
FREE



CRAMPED
HAZY
CONTROLLED

FACTOR IV

FORMAL

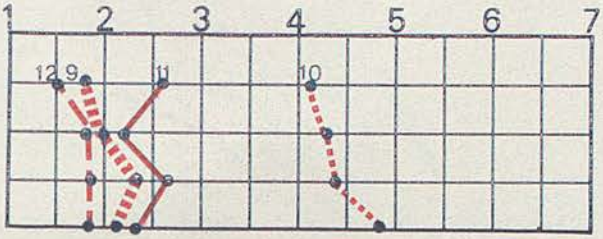


INFORMAL

TABLE 8.11 PRESENTS THE MEAN RATING OF THE MOST & LEAST PREFERRED ARRANGEMENTS ON EACH FACTOR

FACTOR I

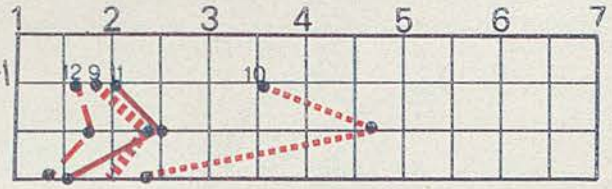
FRIENDLY
PLEASENT
BEAUTIFUL
LIKE



HOSTILE
UNPLEASENT
UGLY
DISLIKE

FACTOR II

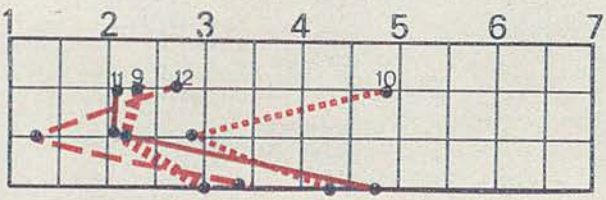
VISUALLY WARM
EXCITING
RADIANT



VISUALLY COOL
BORING
DULL

FACTOR III

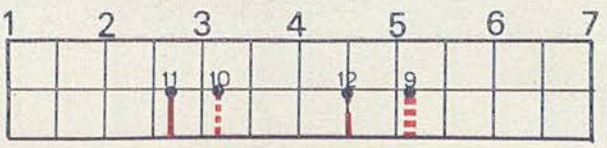
SPACIOUS
CLEAR
FREE



CRAMPED
HAZY
CONTROLLED

FACTOR IV

FORMAL

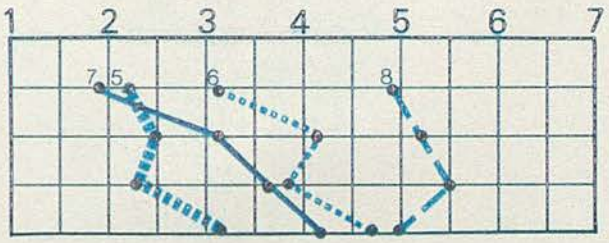


INFORMAL

TABLE 8.12 MEAN RATINGS OF THE ROOMS WITH RED HUE, TWO VALUES AND TWO DIFFERENT LIGHTING PATTERNS

FACTOR I

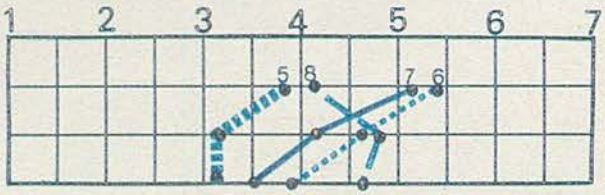
FRIENDLY
PLEASENT
BEAUTIFUL
LIKE



HOSTILE
UNPLEASENT
UGLY
DISLIKE

FACTOR II

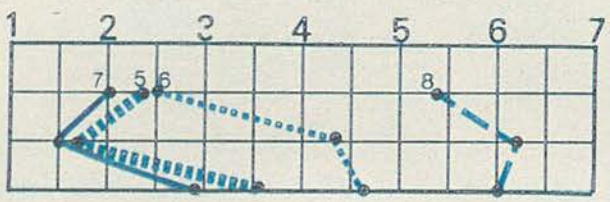
VISUALLY WARM
EXCITING
RADIANT



VISUALLY COOL
BORING
DULL

FACTOR III

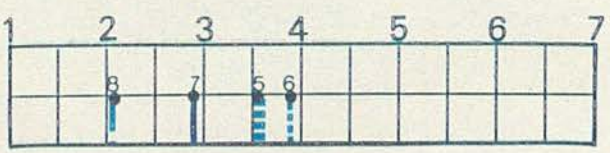
SPACIOUS
CLEAR
FREE



CRAMPED
HAZY
CONTROLED

FACTOR IV

FORMAL



INFORMAL

TABLE 8.13 MEAN RATINGS OF THE ROOMS WITH BLUE HUE, TWO VALUES AND TWO DIFFERENT LIGHT PATTERNS

CHAPTER NINE

CONCLUSION AND SUMMARY

The objective of this research was to provide architects and interior designers with some design guidelines on colour selection derived from a series of investigations of the perceived psychological needs, attitudes and behaviour towards colour of the people who would be working in the office.

In reviewing the literature it was found that a confusion exists in defining the field of environmental psychology and more generally the absence of a theory for this field. As was evident from the review of the literature of various phases of research in environmental psychology, the absence of a general theory has been detrimental to efficient research, and this in turn has made it difficult to extract generalizations from the work of different investigators.

As a consequence, the first major objective in the present research became to develop a rationale for the selection of a conceptual framework by gathering supportive evidence from the available literature and by conducting several case studies.

Three categories of emotional responses related to "Pleasantness", "Control" and "Excitement" have been found to be representative of a wide variaty of responses to the physical environment. These emotional responses were then used to measure the effect of a number of physical stimuli in the environment, (Chapter 7 and 8).

At the commencement of this research, in an attempt to construct a semantic scale for the evaluation of interior spaces and hence searching for further support of the three emotional dimensions mentioned above the investigator ran several parallel studies related to residential and working environments. In brief, numerous visits were made to middle-income and low-income homes. The residents were shown a picture of a living room* and were asked to express their feelings about this space through descriptive adjectives. These adjectives then formed a second questionnaire which was used to measure the impression of the same living room, on a scale of 1 to 7, by a number of subjects (44 male and 37 female, age 22-47) who had not yet participated in the study.

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*This picture was taken from an actual living room by the investigator while running a series of investigations comparing colour preference and furniture arrangement between middle class and working class families. This series of studies is not included in this thesis.

All the subjects used in these studies were residents of low and middle income families of Edinburgh-Scotland, and were visited in their homes. The resulting responses were factor analyzed using a principal component factor analysis, (see App. VII-A Table 9.1 and 9.2).

In additions, the descriptive adjectives elicited from Case Study III-B, Chapter Four, formed a questionnaire and were used by the office workers (28 male and 33 female, age 23-50) of various clerical offices to rate their emotional responses to their working environment on a scale of 1 to 7. These responses were also factor analyzed and are presented as App. VII-A, Table 9.1 and 9.3.

The analysis of the above studies provided further suport for the notion of the three dimensions of emotional response mentioned above.

This concept seems to offer a promising framework within which we can provide a bank of data which will eventually assist in establishing some hard facts helpful to designers in their decision making.

As this research initially aimed to provide design guidelines for colour selection for office interiors, a series of interviews were conducted with office employees in general clerical positions (Chapter Four). This study clearly illustrated a general concern about colour, and the lack of serious consideration of it.

Chapter Five through Eight provide further support of the event of the effect of colour in the environment. The results of these studies are given tentatively. However, they successfully illustrate that the effect of colour can go as far as to influence the impression and judgement of people and also, the preferred arrangement of furniture within a space. Hence, affecting the approach-avoidance response of the users to the situation.

A general warm colour scheme was found to be favoured by the majority of the subjects. Three hues (red, yellow and blue) and gray with constant value and chroma were introduced on the walls as the main colour variables in these experiments. The colour red generaly gathered more posivtive responses than blue. This is some-what novel as pink has been considered as perhaps the forbidden colour and not suitable for offices or other similar spaces.

However,

> [... Clinical psychologist Alexander Schauss, Director of the American Institute for Biosocial Research in Tacoma, Washington, spearheaded the now widespread use of bubblegum-pink rooms to calm delinquents and criminals in correctional facilities across the country.
>
> In 1979, Schauss evaluated the effect on subjects as they looked at this pink shade on a piece of cardboard. He reported later that they did not perform simple strength tests as well as they did when viewing other hues.
>
> A U. S. Navy Brig in Seattle took notice of Schauss' work and permitted him to test his calming colour hypothesis on its inmates. Now hundreds of institutions place individuals in pink rooms when tempers flare.
>
> "We used to have to give them drugs, even use handcuffs", says Paul Bollumini, Director of Clinical Services at California's San Bernadino County Probation Department. "But this works"!][2]

Tangentially Schuass and Wholfarth are not certain how colour can have an impact on biology or behaviour. But Schauss says response to colour is determined in the brain's reticular formation, a relay station for millions of the body's nerve impulses.

There have been studies indicting that warm hues, such as red, orange or yellow, raises the blood pressure, respiration becomes faster and perspiration greater. In the late 1970's a UCLA study showed that blue had the opposite effect.

Given this data, many researchers speculate that the perception of colour by the eye ultimately spurs the release of important biochemicals in the body. This speculation is of course still open to further investigation.

In another situation, a recent study at a school in Wetaskiwin, Canada, revealed that after a change in the school's colour and lighting scheme, the IQ scores of many students jumped and absenteeism and disciplinary problems decreased[2]. This study was conducted by the visual-arts professor Harry Wohlfarth of the University of Alberta, and it involved substituting yellow and blue for orange, white, beige and brown and replacing fluorescent lights with full-spectrum ones.

The case studies reported here also demonstrate that studies of single stimuli in this line of research does not necessarily provide realistic information for the designer as they are often concerned with the effect of one stimuli on emotional responses. We perceive the environment as a whole, and hence are affected by the interactive effects of the physical stimuli in any given environment. This point is demonstrated in Chapter Eight where, for example, a non-uniform lighting arrangement was not necessarily preferred over the other type of lighting arrangement but, it was the interaction of light pattern with the hue an value of the walls that made a situation more exciting, pleasing, and/or dominant. This is in contrast with the studies in which the lighting condition is generally demonstrated to be preferred over another[3-4-5].

The results of the case studies reported here are given very tentatively and are indeed open to future research for the test of their validity. However, the main point that became evident during this research, and, through numerous interviews with the staff of various offices visited, is the extent of a conscious awareness of colour and the physical appearance of the working environment, and the lack of any purposeful and serious consideration of its arrangement.

Throughout the initial process of designing a building and during its subsequent life, colour application is a recurring task. One which depends on more than just intuition if satisfactory results are to be achieved. Consequently a purposeful selection requires consideration of all the functional and affective aspects of colour.

Psychology has shown that colour plays a vital part in ensuring a widely experienced existance. It also provides a stimulus for a language of emotional response. However, these simple observations are often ignored by those responsible for designing our environment.

Architects often seem to conceive architecture as a colourless science, which has led to the construction of dull and uninspiring environments. Many Architects visualise beauty strictly in terms of form, wholly divorcing colour from their consciousness. Which leads one to believe that perhaps an Architect only distinguishes fall from winter by form and temperature!

Almost always colour is the last consideration. Often an architect creates a grey mood with gray materials and then proud of his creation, he hires an Interior Designer to, 'perk it up', by lending a few touches of charm here and there in order to make it more saleable! The Interior Designer in turn, in an attempt to create a picturesque environment, often imposes his taste of colour and style on the client without an informed understanding of the relevant psychological and physical effects.

As interior design becomes more separated from decoration and moves towards that of interior architecture, designers are beginning to follow the traditional approaches of Architects. As this approach advocates separation of colour and form, the Interior Designer often approaches space planning as an isolated process. Colour and texture are then applied as the last touch-ups!

The blame cannot be solely laid at the door of the professional organisations, but also to the educational system. In our schools and colleges the study of colour is either ignored or approached as an isolated visual experience which occurs at the last stages of planning and design. Colour has to appear in the early stage of any design and must be studied in conjunction with space planning and the creation of architectural form, not as an after thought which often seems to be the case. To consider light and colour as adjuncts to architecture reduces real effectiveness.

Many Architects and Interior Desingers appear to have been educated in the Bauhaus tradition which relies heavily on the use of three dimensional gray cardboard models in the design process. These models intentionally inhibit any display of of material, colour or texture. Furthermore, obsessed with functionalist philosophy, Architects limit the meaning of function to factors such as utility and technology.

This view has resulted in too many cold and uninspiring machine like environments. These environments in turn have had considerable influence on the psychology and well being of its users. As Winston Churchill once said, "we shape architecture and it shapes us".

Architects who think in terms of black and white are either frightened of colour, or ignore it by hiding behind functionalist philosophy. The drab results are around for all of us to see. This conservative belief of "functionalism" seems no longer adequate and we need a rather broader perspective which considers all the facets which contribute to the creation of an environment suitable for human functions, both physical and psychological.

As our towns and cities grow in size and number, it seems that we are in danger of not only losing the natural landscape, but also the wealth of colour we seem so reluctant or ill-equipped to replace. If we are to avoid the possibility of future gray, monochromatic towns and cities, we must reorientate our concepts of space from form relationships, towards a deeper awareness of coloured space and coloured form. We must accept colour not as a separate element, but as one totally integrated into the visual experience.

It is essential for the Architect and Interior Designer to realize that colour is indeed needed for the physical and psychological well-being of human beings. This need is clearly illustrated by the fact that people tend to select their clothing to complete or compliment their individual colouration, and to seek identity. They further colour the inside of their living spaces to suit their expectations. This seems to fulfill a basic need, as we usually associate colour with happiness and lack of it with sadness, bordom and depression.

Colour is often associated with spatial reduction, expansion and weight. It is also claimed that it could compensate for inadequate heat, acoustics, etc.[6-11]. Colour has been used therapeutically in dealing with emotionally and/or mentally ill patients[12-13-14]. Clinical Art Therapists have observed that patients with inclinations to suicide tend to use yellow pigment generously in their paintings as indeed did Vincent Van Gogh. However, there is a wide belief yellow stimulates the intellect and thus has been prescribed as a suitable colour for libraries and classrooms. An intense use of this colour however may incite children to vandalism.

Experimental studies have also shown that colour-blind animals have been physically affected by coloured light. This is particularly evident in relation to their sexual behaviour. In addition, it has been noticed that coloured light has profound effects in determining the sex of rats, mink, and fish. Breeding under blue illumination seems to produce more females, and under red light more males[15-16-19]. How far these findings are valid for humans is yet to be investigated. Coloured illumination behaves in an entirely different way to surface pigment, nevertheless this proves that colour can stimulate psychological and physical reactions.

Studies of the evolutionary scale in animal behaviour by zoologists suggest that territoriality does not only zone physiological needs of the animal, but also the psychological desires; for example the need for security, stimulation and identity. It is not surprising to find that human motivation and behaviour are usually compared with animal studies. As many neurologists have suggested the nervous system not only reacts to stimulation, but the brain needs constantly varying forms of stimulation in order to operate in relation to the environment. In brief, "variety is not the spice of life,, it is the very stuff of life[18-19]!" Towards this end colour is one of our most economical and versatile tools.

By Way Of Concluding

Colour is part of a total sensory experience of the world we live in. It contributes unlimited beauty to the world, while as an integral part of our visual system, helps to identify and define objects in space and acts as a signalling device to convey information about our environment. It is well established that colour and light are essential to all forms of life, radiant energy enters through the eyes, penetrates living tissue, stimulates glandular response, metabolism, hormone development and the entire autonomic system, respiration, heart action and appetite.

Furthermore, we need sensory stimulation to keep our spirit and soul together. This involves colour and other sensory interests. There should be a resourceful and dynamic use of colour in the spaces we live for proper mental and emotional balance.

As our civilization advances and at the same time grows away from nature, we must try to utilise to the fullest all the factors which can help us to maintain our well-being. Colour is among those factors. However, every Architect, Interior Designer or Researcher who finds these thoughts of interest will agree that studies on colour and recommendations for colour schemes as they have for instance been made by the Colour Council, are just as one-sided and incomplete as the recommendations for lighting levels and the light. We need linked-approach studies of interactive effects of physical stimuli in an environment before we can come up with prescriptions on how to use various design elements to acheive a higher level of human well-being. After all, is not human welfare what everyone is seeking?